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MONTHLY WEATHER REVIEW

AUGUST 1949

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[redacted]

CORRECTION

[redacted] REVIEW, July 1949, pp. 77, Severe [redacted] Report: Issued 27 July 51, in Todd, Stearns, Wright, and [redacted] Hennepin counties, Minn., amount of property damage should read $24,000 instead [redacted]

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TEXAS-WEST GULF CYCLONES*

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ABSTRACT

From a study of 388 extratropical cyclones originating in the Texas-West Gulf region during a 40-year period various characteristics of their formation and early life history are determined. Some of the common synoptic sequences leading to the formation of these cyclones are derived from a more thorough study of recent synoptic charts and are described from the standpoint of the upper-air circulation. The 388 selected cyclones are summarized in terms of variations in frequency, favored regions of origin, motion, deepening, and relation to the rainfall of the central Gulf coast. The relatively great frequency of cyclone formation near the Texas coast is considered to result from the interaction of the general circulation on the unique physiographic environment of the region.

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INTRODUCTION

The weather and climate of the eastern United States during the cooler months of the year are influenced to a large extent by the frequency and behavior of extratropical cyclones originating near the northwestern coast of the Gulf of Mexico. These "Texas-West Gulf Cyclones," often referred to as "Texas Cyclones," appear under different conditions of low-level atmospheric circulation; also, similar synoptic situations may or may not produce cyclones. The cyclones exhibit not only variable frequencies of occurrence but also variable degrees of development. In some situations cyclones forming along the western Gulf Coast of the United States disappear or move away in the prevailing currents without further intensification; in others, they develop into storms of large magnitude, affecting most of the eastern states. In view of the idiosyncracies of these cyclones several interrelated types of formative sequences are described. Later, the statistical features of the cyclones are discussed.

For the purposes of this study the Texas-West Gulf cyclone was defined as the extratropical surface cyclone which, from evidence on daily sea level synoptic charts, formed within a designated area (fig. 11) and which persisted as a distinct cyclonic circulation for at least 24 hours. The area was bounded by the 89th and 105th meridians and the 25th and 34th parallels; the extreme southwestern corner in the Sierra Madre was excluded from the area. The general outline of the land area is similar to the one used in an earlier study of this nature by Bowie and Weightman [1], theirs being bounded on the north by the 35th parallel of latitude. This difference possibly accounts for some of the different results in climatic statistics.

SEQUENCES IN THE FORMATION OF THE CYCLONES

The important cyclone formations in the Texas-West Gulf region are associated with renewed upper level cyclonic activity near the 100th meridian in the form of

* Adapted from a master's thesis entitled *Climatic and Synoptic Aspects of the Texas Cyclone*, The University of Chicago, August 1947, of which part was reviewed at the Chicago meeting of the American Meteorological Society, December 29-30, 1947.

either a closed circulation or an extended trough through central North America at some time following a cold air outbreak over the central states. Just as the cyclones follow variable modes of development after their detection at the surface, there are different degrees of attendant flow pattern. A suitable description of this cyclogenesis required a break-down or division of the cyclones into a convenient number of categories depicting the usual formative stages. Groups were formed by determining the common sequences of changes preceding cyclogenesis and the common patterns both preceding and attending the new formations at the surface. Admittedly, no rigorous classifications were made; the ones adopted serve only to describe some dominant yet simple features in this cyclogenesis without attempting to explain the dynamics of cyclogenesis.

The formulation of cyclone groups resulted from a detailed analysis at two or more levels of the atmosphere of all cases occurring between October 1932 and December 1938 and from 1943 to 1947, and from brief surface synoptic summaries written for each cyclone case from 1899 to 1938. The charts used for this purpose included the *Historical Weather Maps, Daily Synoptic Series, Northern Hemisphere Sea Level, 1899 to 1939; Historical Weather Maps, Daily Synoptic Series, Northern Hemisphere, 3,000 Dynamic Meters, 1932–38;* twice-daily sea level and 10,000-foot (or 700-mb.) Northern Hemisphere charts, 1943–46, prepared by the Extended Forecast Section of the U. S. Weather Bureau; and daily 1,000-mb. and upper-level Northern Hemisphere charts, 1946–47, prepared at the University of Chicago.

A first condition common to all of these cyclones is the presence of polar or arctic air at the surface over the United States. Only one minor group of cyclones occurs when surface tropical air is present west of the Appalachians. Otherwise, polar air covers the entire country north of the latitude of the impending cyclone. This polar air can possess almost any degree of modification; empirically, the fresher the polar air the more the cyclone development resembles that of the polar front wave model. Although the polar front *at the surface* usually becomes increasingly indistinct while moving southward over the Gulf of Mexico and neighboring regions, the solenoid field associated with the front in levels above the surface is maintained for a considerably longer period of time. Low level convergence and a usual deformed field of motion in a developing cyclone, placed on the temperature field near the Gulf Coast, can aid in the reactivation of the polar front even at times when the front has apparently lost most of its significance. It is evident that the polar front, an accepted mechanism in the general circulation, does partake in this coastal cyclogenesis.

The cyclones studied were separated into two main divisions based on the source of their formation. These were further subdivided according to special features of formation.

A. CYCLONES FORMING FROM THE SOUTHWEST COLD-CORE LOW

The most determinate type of formation, yet possessing masked sequences at the surface, is manifest through the eastward motion of an upper cyclonic center from the extreme southwestern United States or the vicinity of Lower California. These cold-core cyclones are frequently isolated for periods of days near the coast of southern California and very often have indifferent pressure distributions at the surface. The eastward movement of such a center across the Rockies provides for a reliable type of surface cyclogenesis near the northwestern coast of the Gulf of Mexico if the pre-existing conditions there are favorable. Those centers having significant sea level low pressure areas which can be traced across the mountains generally show surface intensification as they reach the Gulf region, but for the purposes of this study such transient cyclones were not included. Over the Texas region several variations of development arise, depending on the circulation pattern and on the low-level air-mass structure east of the Rockies. All cyclones which resulted from the Southwest Low were placed in either of two groups which have distinguishing features.

Group 1. Low Latitude of the Westerlies East of the Rockies.—The first group of cyclones is most frequent during the winter months. This type of cyclone forms along a usually well-marked and persistent quasi-stationary front oriented along the northern Gulf Coast; this condition is attended by a low latitude position of the westerlies to the east of the Rockies. The synoptic pattern before cyclogenesis includes a broad cold anticyclone or north-south ridge at the surface dominating the United States east of the Rockies, upper cyclonic flow above this cold air, the polar front extending from the western Atlantic through the extreme southeastern United States, an indifferent or flat surface pressure distribution southwest of the Continental Divide, and a warm anticyclone situated north of its normal position in the extreme eastern Pacific with a ridge extending northward over the Canadian Rockies (figs. 1(a) and 1(b)).

The eastward motion of the upper cyclonic center is an essential mechanism in the formation of these cyclones. The displacement of this center is related to circulation changes in the Pacific, among them being a southward displacement of the Pacific anticyclone and of the upper westerlies lying north of this anticyclone; it is probable that there are also some common sequences in the Central Pacific. After the upper cyclone has become dislodged from its stationary position it moves eastward in the prevailing westerly current until it becomes an integral part of the circulation in the east. Evidence of pending cyclogenesis can be obtained from surface synoptic reports only after the upper center has begun to move toward the Gulf Coast. The precipitation with the resulting surface disturbance is usually widespread and steady. Since the surface air north of the front is coldest with this type of formation, these storms are the most conducive to sleet or glaze formation in winter

An example of this type of cyclogenesis is shown by figures 1(a) to 2(b). The sequence represents a very rapid formation along a clearly marked frontal surface. The conditions outlined above are prominent on the charts for the first day, February 19, 1947. Although the cut-off Southwest Low is very evident at 700 mb. and is even more pronounced in the higher troposphere, there is lack of its evidence from the sea level chart. During the succeeding 24 hours this center was traced

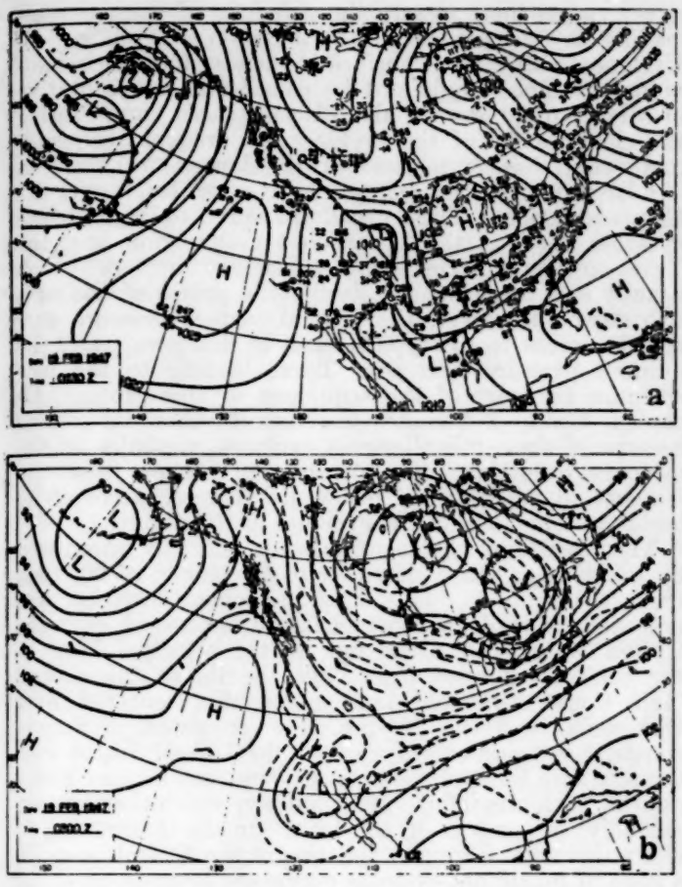

FIGURE 1.—(a) Sea level weather map, 0630 GMT, February 19, 1947. (b) 700-mb. chart, 0300 GMT, February 19, 1947. Solid lines are contours labelled in hundreds of feet; dashed lines are isotherms in °C.

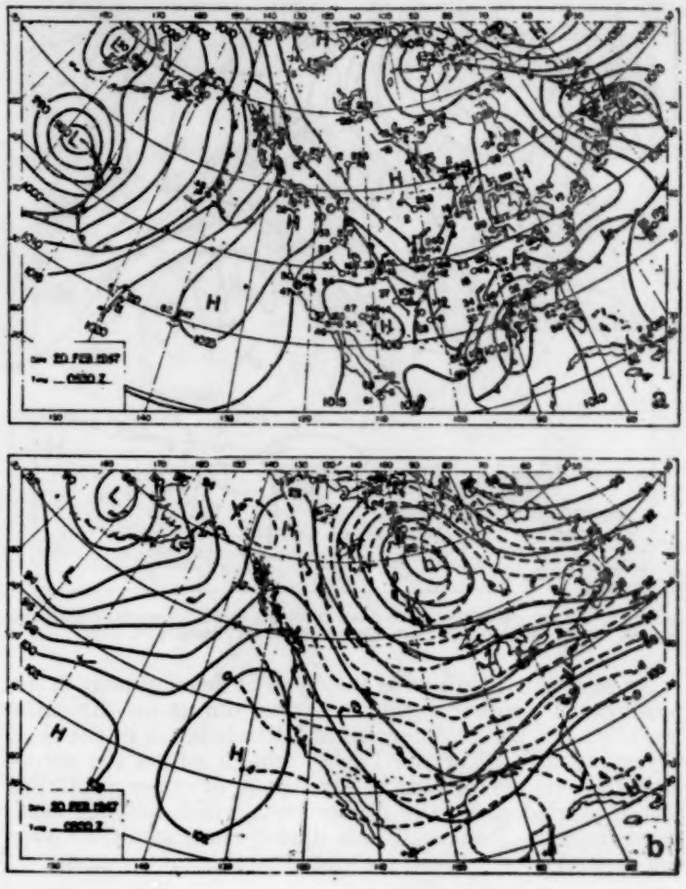

FIGURE 2.—(a) Sea level weather map, 0630 GMT, February 20, 1947. (b) 700-mb. chart, 0300 GMT, February 20, 1947. Solid lines are contours labelled in hundreds of feet; dashed lines are isotherms in °C.

in its rapid motion eastward. On the chart for February 20 it is shown over the vicinity of Arkansas. The new cyclone at the surface is now part of this same system. The eastward motion of this Southwest Low coincided with a southward shift of the Pacific anticyclone which in turn responded to pressure falls on its northwest side.

Group 2. High Latitude of the Westerlies East of the Rockies.—The other major subdivision of cyclones forming with the motion of a Southwest Low is most frequent during the autumn months. It is associated with fundamentally high-index [2] conditions over North America. The surface synoptic picture before surface cyclone formation is similar in some respects to the one in the first group, including the same general frontal orientation in the east. However, in this case the principal stream of westerlies has less amplitude at 700 mb. and is found at a higher latitude, near the Canadian border; the greater part of the cool air over the United States has come directly from the Pacific Ocean, the air east of the Rockies having been considerably modified in its trajectory, and a large portion of the cold air at higher levels having remained west of the Rocky Mountains to become associated with the Southwest Low. The polar front in the southern United States is weaker than in Group 1. At the surface the ridge line usually has a west-east alignment over the central United States with a flat anticyclonic center over the eastern States and another center over the Great Basin region or southwestern Canada. Beneath the main stream of upper westerlies there is often a secondary frontal or frontogenetic zone lying parallel to the upper flow near the northern border of the United States. This zone is usually referred to as the Arctic front.

During such periods of westerly flow frequent cyclonic perturbations are able to enter the northwestern States or British Columbia from the Pacific. The approach of one of these troughs in the westerlies with its attendant region of pressure falls produces a progressive southward increase of the west wind on the west coast. As in the previous case this appears to affect the stationary equilibrium of the Southwest Low, and it consequently moves eastward. East of the Rockies it may become associated with a Texas or Gulf Coast cyclone development and unstable forms of precipitation along the weak polar front. Figure 3 shows a Gulf Coast cyclone which formed from this sequence of changes. Several cyclones of this type occurred at regular intervals during the first half of January 1946, while the afore-mentioned pattern persisted for an unusually long period.

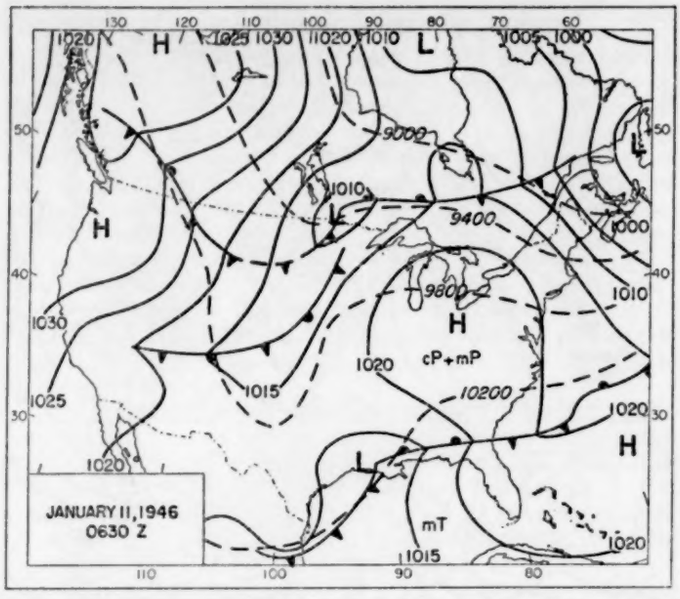

FIGURE 3.—An example of Group 2 cyclones showing sea level isobars (solid lines) and fronts, and 700-mb. contours (dashed lines) 0630 GMT, January 11, 1946.

An additional feature of this type of development is the presence of another surface cyclone almost on the same meridian but 20 to 25 degrees of latitude north of the Gulf Coast storm. After the Pacific trough enters the continent the cyclone remains in the stream of upper westerlies and is carried along the Arctic front which extends eastward from the Rockies. This dual cyclone structure over the United States is not restricted to this group alone.

B. CYCLONES FORMING FROM THE GREAT PLAINS TROUGH

The second major division of cyclones is attended by the redevelopment, or retardation of an upper trough of large amplitude just east of the Rockies. The first two groups (Groups 3 and 4) of cyclones in this division are associated with the retrogression or discontinuous redevelopment of the upper trough immediately following a cold air domination of the eastern half of the United States. The surface pressure distribution over the United States is consistently composed of two separate anticyclonic cells, one west of the Continental Divide and the other associated with the cold air to the east. During the two days preceding cyclogenesis there are persistent pressure falls at most levels near the 100th meridian, and net pressure rises near the Atlantic and Pacific coasts. The eastern anticyclone extends to higher and higher levels and moves northeastward; it is usually centered over the northeastern states when the new cyclone develops.

In contrast to the cyclones in Groups 3 and 4, those in the final group (Group 5) in this division form with the primary outbreak of cold air and in conjunction with the marked deceleration and persistence over the Plains of a previously eastward-moving upper trough.

Group 3. Retrogressive Upper Trough.—Group 3 comprises the largest single group of cyclones and basically it represents most clearly the principle of the processes leading to cyclogenesis in the Texas-West Gulf region. Cyclones with related surface sequences for which individual examples could not be considered representative of a large number were also placed in this group during the classification of the cyclones. A frequent sequence involved in these extra cases was the slow eastward motion of a large trough or closed cyclone at upper levels over the Colorado region. These usually gave rise to large surface cyclones north of the Texas-West Gulf region, and the Texas cyclones were small subsidiary centers which usually lost their identity during the course of the next two days. However, the general surface pressure pattern is similar to the typical cases of this group, and the induced pressure falls over Texas leading to the new cyclones are part of the sequences of this group. Although Group 3 becomes less definite than the others because of these miscellaneous cyclones, statistics on the cyclones occurring after October 1932 show that the features to be described below are representative of no less than four-fifths of the cyclones in the group.

The description of this group is conveniently introduced by referring to the typical case of December 19–20, 1946 (figs. 4 (a) to 5 (b)). This particular situation was preceded by cold air movement southeastward over the United States. On December 18 the principal front at the surface extended from Nova Scotia to the central Gulf Coast, the cold anticyclone was centered over Oklahoma, and the 700-mb. flow consisted of almost constant cyclonic curvature over the United States with the southern limit of the pressure contours located about on the 90th meridian. The pattern was otherwise essentially the same as on the 19th. In the intervening 24 hours there was apparent splitting of the 700-mb. trough, a zone of maximum cyclonic curvature forming on either side of the trough position of the previous day and pressure rises occurring between these two troughs. At the surface the front progressed slowly southeastward while appearing to weaken in the vicinity of the Gulf of Mexico. The cold anticyclone moved northeastward while intensifying. Pressure falls continued east of the Rockies with a large isallobaric center located in west central Canada. By the 20th the Great Plains trough at 700 mb. had become sharper and moved slowly eastward toward the Gulf; it had now become the major trough over North America. On the surface chart a new frontal wave with weather appeared on the Gulf Coast, where the front was previously undergoing dissolution. Its formation there along the reactivated polar front followed large scale atmospheric changes which took place in a period of several days.

The fact that during this sequence the flow pattern over the west coast of North America and the extreme eastern Pacific remained almost constant on the successive days precludes an explanation of the new major trough by its motion from the Pacific. There was trough intensification to the rear of the previous trough such that the net 48-hour change was equivalent to retrogression by 10 degrees of longitude at 700 mb. This change appears to have been part of a large readjustment process in the hemispheric circulation which is suggested in figure 6 by the successive daily positions at 700 mb. of the 10,000-ft. contour which was located along the southern edge of the

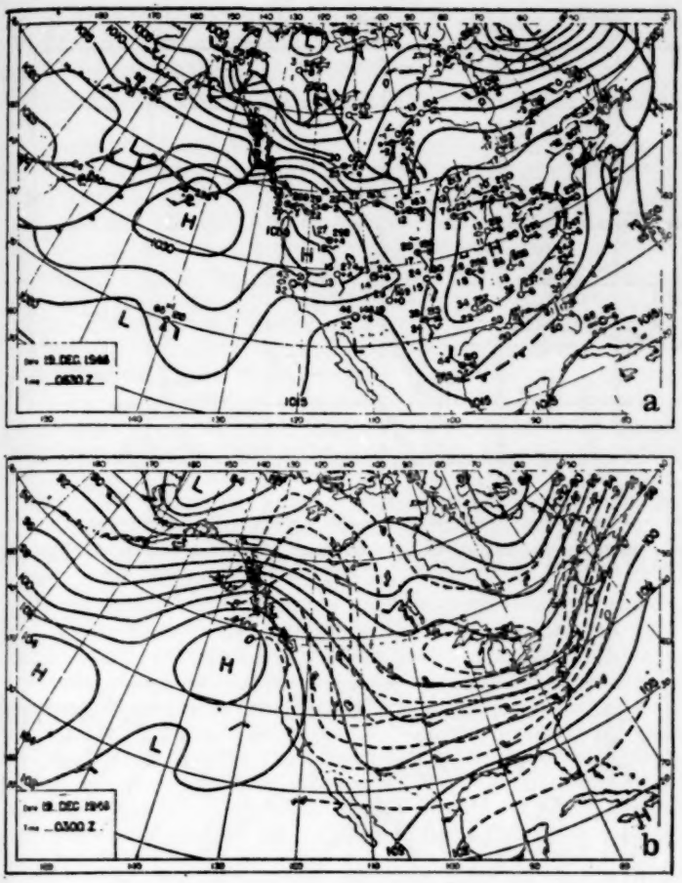

FIGURE 4.—(a) Sea level weather map, 0630 GMT, December 19, 1946. (b) 700-mb. chart, 0300 GMT, December 19, 1946. Solid lines are contours labelled in hundreds of feet; dashed lines are isotherms in °C.

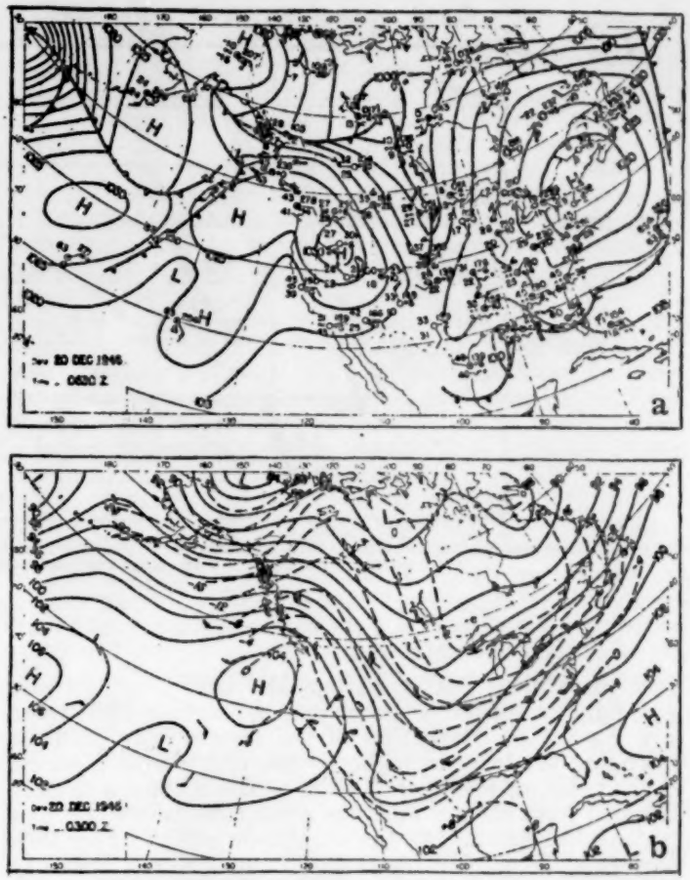

FIGURE 5.—(a) Sea level weather map, 0630 GMT, December 20, 1946, showing a deepening wave cyclone on the Gulf Coast and the co-existence of cyclonic circulations on the northern and southern borders of the United States at almost the same longitude. (b) 700-mb. chart, 0300 GMT, December 20, 1946. Solid lines are contours labelled in hundreds of feet; dashed lines are isotherms in °C.

main westerly current and which passed through the southern United States. Troughs B and C showed the usual eastward motion during the four days. The cyclonic intensification to the rear of both B and C led to acceleration and filling of these two troughs. Intensification in the rear of the Pacific trough was followed in about two days by a similar process over North America while the West Coast ridge underwent only minor changes. This readjustment is in accord with the description of the interdependence of large-scale systems in the circumpolar westerlies [3] and with Rossby's [4] discussion of downstream propagation of energy in atmospheric waves. Although the more common type of retrogression observed was of the form in which a trough of very small amplitude in the northwesterly current was subjected to intensification, the essential features are the same.

The importance of this retrogression in the formation of surface cyclones in the Texas-West Gulf region is revealed by the fact that 22 of the 25 cyclones of this group which occurred between 1932 and 1938 resulted from this same process. In each case there was either a similar retrogression or an intensification of the southerly current in the central Pacific prior to or simultaneous with the retrogression in North America.

Group 4. Discontinuous Redevelopment of the Upper Trough.—The next group of cyclones associated with the development of a Great Plains trough at upper levels possesses a less common and more restrictive type of formation, but occurs with even more abrupt changes in the flow pattern over the United States. These cyclones are associated with somewhat later stages of the cold spell in the east. Following a cold outbreak similar to the one of December 18–19, 1946 (fig. 4(a)), the main current of westerlies may shift northward over the United States with relaxation of meridional flow. Such a change ordinarily presages fair and mild weather for most of the States. The general warming coincident with this shift does not necessarily involve movement of tropical air

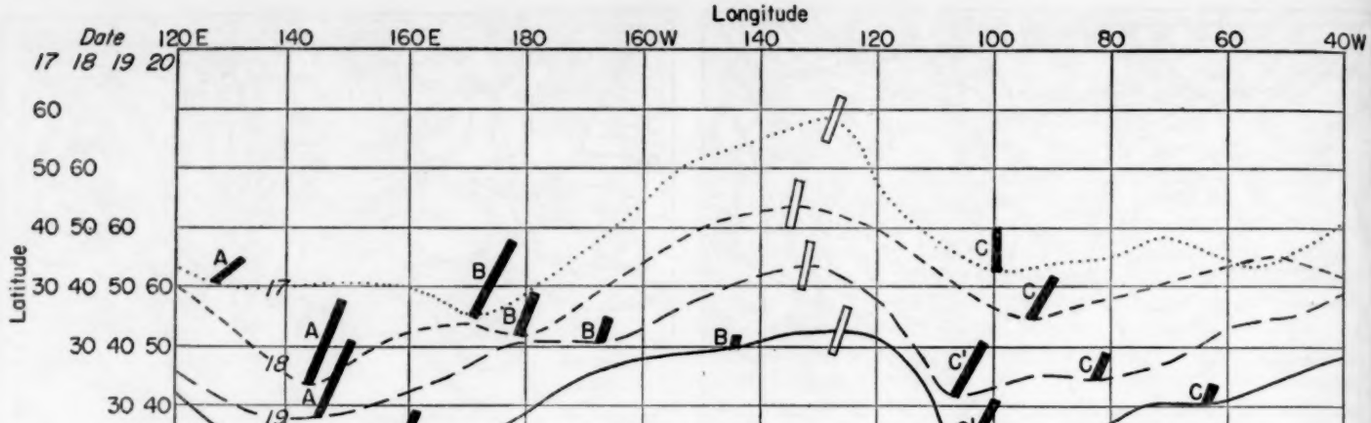

FIGURE 6.—Successive daily positions of the 10,000-ft. contour at 700 mb. December 17–20, 1946. The slope and length of the solid shafts represent the orientation and relative intensity of the troughs respectively. (All data taken from charts prepared by Extended Forecast Section, U. S. Weather Bureau.)

over the United States; rather, the Gulf front appears gradually to weaken or dissolve at the surface while there is a lag in the dissipation of the temperature gradient attending the front in higher levels, and warming occurs in the polar air itself. The front at the surface is usually dropped from surface analyses some time before the new cyclone formation. As the amplitude of the upper flow decreases, the northern section of the west North American high pressure ridge becomes of less influence, and disturbances from the Pacific begin to penetrate the continent at the latitude of the stronger westerlies.

One of the first of these minor troughs which cross the mountains appears to be a nucleus of trough intensification leading to the Texas cyclone. Usually following marked cyclonic intensification in the Pacific between longitudes 180° and 140° W., pressure rises occur in the western and eastern States, and there are pressure falls of initially smaller magnitude over the Plains. This phase of the process has been discussed by Cressman [5] in using the situation which led to the cyclogenesis in western Texas shown in figure 7. The surface pressure falls are concentrated in two centers, the major and sustained one over Texas, the minor and temporary one with the surface cyclone in the Dakota-Montana region. Surface and upper cold air begin moving rapidly southward east of the mountains while a sharp and extended upper trough is formed there. The Dakota cyclone decelerates and is subjected to slow filling. As the cold air continues to move southward, the surface cold front which separates the two polar air masses assumes a north-south alignment in the Mississippi Valley. The Texas cyclone develops along this front (fig. 7), although there are many cases in which the cyclone first appeared east of this front. With the strengthening of the cyclonic circulation surface tropical air is brought into the new cyclone which then acquires some characteristics of the usual frontal wave.

The sequence described above usually takes place in two to three days. It is also necessary for this rapid

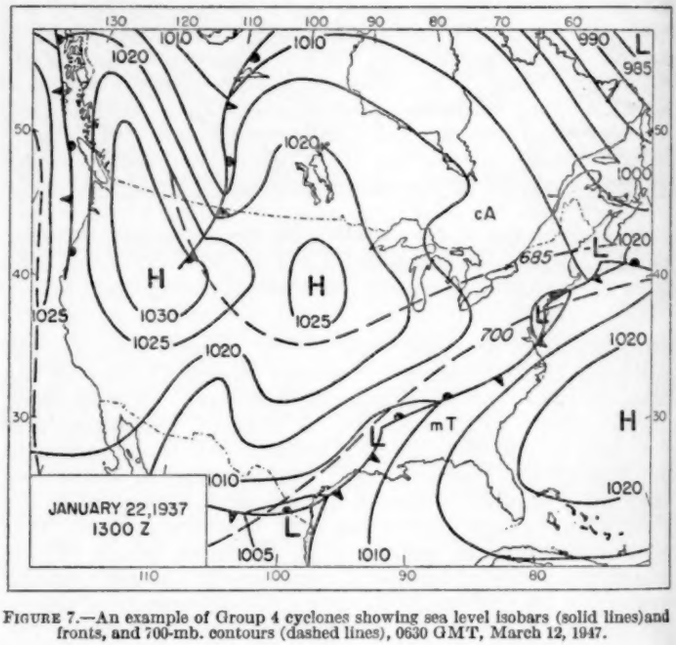

FIGURE 7.—An example of Group 4 cyclones showing sea level isobars (solid lines) and fronts, and 700-mb. contours (dashed lines), 0630 GMT, March 12, 1947.

cyclogenesis that the major portion of the southward moving cold air be located east of the Rocky Mountain range; otherwise, the cold air could stagnate west of the mountains for some time and different situations would result. Therefore, the location of the major wave pattern in the eastern Pacific is an important condition for the location of the deepening Great Plains trough and the resultant Texas cyclone.

The precipitation in the early stages of this Texas cyclone is often concentrated in the eastern or southeastern quadrant of the surface cyclonic circulation at a

considerable distance in advance of surface fronts. It can be of a very unstable nature, particularly if there is rapid intensification of the cyclone. This storm is very conducive to the formation of tornadoes near the Gulf Coast.

Group 5. Persistent Upper Trough.—While the two previous groups account for the cyclones forming in conjunction with discontinuous retrogression of cold troughs over North America and polar air at the surface on both sides of the upper trough, this last group contains the cyclones forming with the primary outbreak. When a large cold trough decelerates sharply or stops over the Plains after normally moving eastward, a situation is set up for the maintenance of a pronounced quasi-stationary front beneath the strong upper southwesterly current. This front, separating very cold continental air from the real tropical air in the southeast, assumes an orientation southwestward to the Texas region (fig. 8), and along the front small waves can emanate at frequent intervals. A suitable description of the pattern involved can be imagined by shifting the mean upper flow pattern of North America and adjacent parts of the oceans approximately 30 degrees of longitude westward. Thus, the Atlantic anticyclone extends into the southeastern states, the mean East Coast trough is found in the central part of the continent, and the western ridge extends northward into the Gulf of Alaska. Although such a pattern is abnormal, it occassionally persists for several days with only slight changes in position. Examples of this sustained situation with numerous frontal waves originating along the sharp front are depicted by charts for much of January 1937. The Ohio Valley floods of that period have been attributed to such an abnormal and persistent pattern [6].

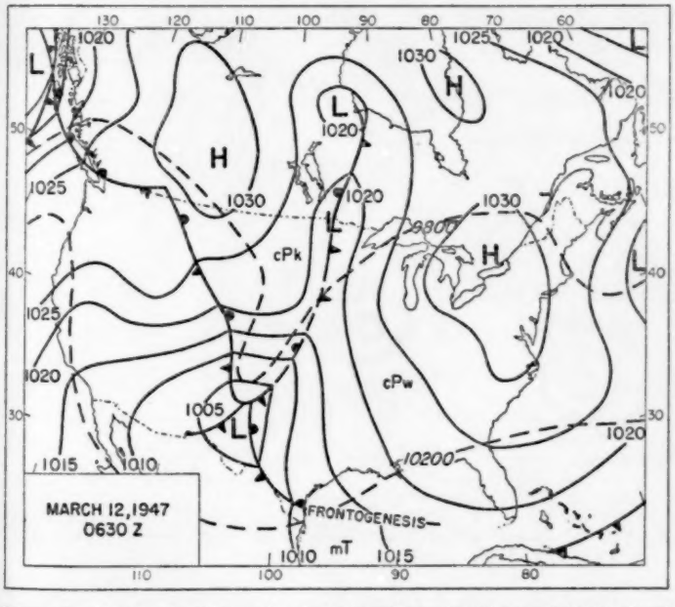

FIGURE 8.—An example of Group 5 cyclones showing sea level isobars (solid lines) and fronts, and 3-km. isobars (dashed lines), 1300 GMT, January 22, 1937.

The Texas-West Gulf cyclones forming under these circumstances are very similar to the more frequent waves described by Miller [7] which form on active fronts extending parallel to the Atlantic coast. This group is the only one in which the cyclone waves are observed to occur in families. These waves seldom reach occlusion before arriving over the northeastern states or the Atlantic. The precipitation is mostly in a relatively narrow band along the path of each wave. The centers move so rapidly along the front and the waves have such small amplitude in their early stages that it is difficult to trace the development of an individual wave on daily charts. This difficulty is believed to have minimized the number of such cyclones which conceivably could have been included in the original selections. There is also a tendency for these small waves to originate along various sections of the front without preference for the Texas-West Gulf region, but the fact that they occur in the region is sufficient reason for including them in the study.

CLIMATIC FEATURES OF THE CYCLONES

The ensuing statistical data are based on the 388 cyclones selected in the manner described in the Introduction from the months October to April of the 40-year period 1899 to 1938. The basic source material consisted of the *Historical Weather Maps, Daily Synoptic Series, Northern Hemisphere Sea Level, 1899 to 1939*, published by the U. S. Weather Bureau, from which all cyclones were selected as a result of a day-to-day examination of the synoptic charts. The cyclone track summaries of the *Monthly Weather Review* provided a means for cross-checking with the daily charts. The number of selected cyclones for the 40 years is closely proportional to the number found by Bowie and Weightman for the same months; the difference amounts to two percent.

DISTRIBUTION OF CYCLONES BY MONTHS

The distribution of cyclone frequencies for each month of the 7-month season during the entire 40 years is represented by an almost symmetrical curve centered on January (fig. 9). The curve assumes even greater symmetry for the season when the frequencies are corrected to months of equal length (approximately 30.3 days). Some distortion of curvature is produced by a rather rapid increase in frequency from November to December and a more gradual decline in late winter and early spring; this distortion approaches that of the rainfall distribution of the Lower Mississippi Valley and the southern Appalachian region for the same months.

There is considerable aperiodic variation in the month of maximum cyclone frequency, and only few seasons are characterized by distributions parallel to the 40-year total in figure 9. The difference between the distribution found by Bowie and Weightman and the one for the 40 years cannot be readily explained. A computation for the overlapping period, 1899 to 1912, confirms their curve by also producing a December maximum. During the remaining years a January maximum was most common; February and March occasionally had the maximum for the season.

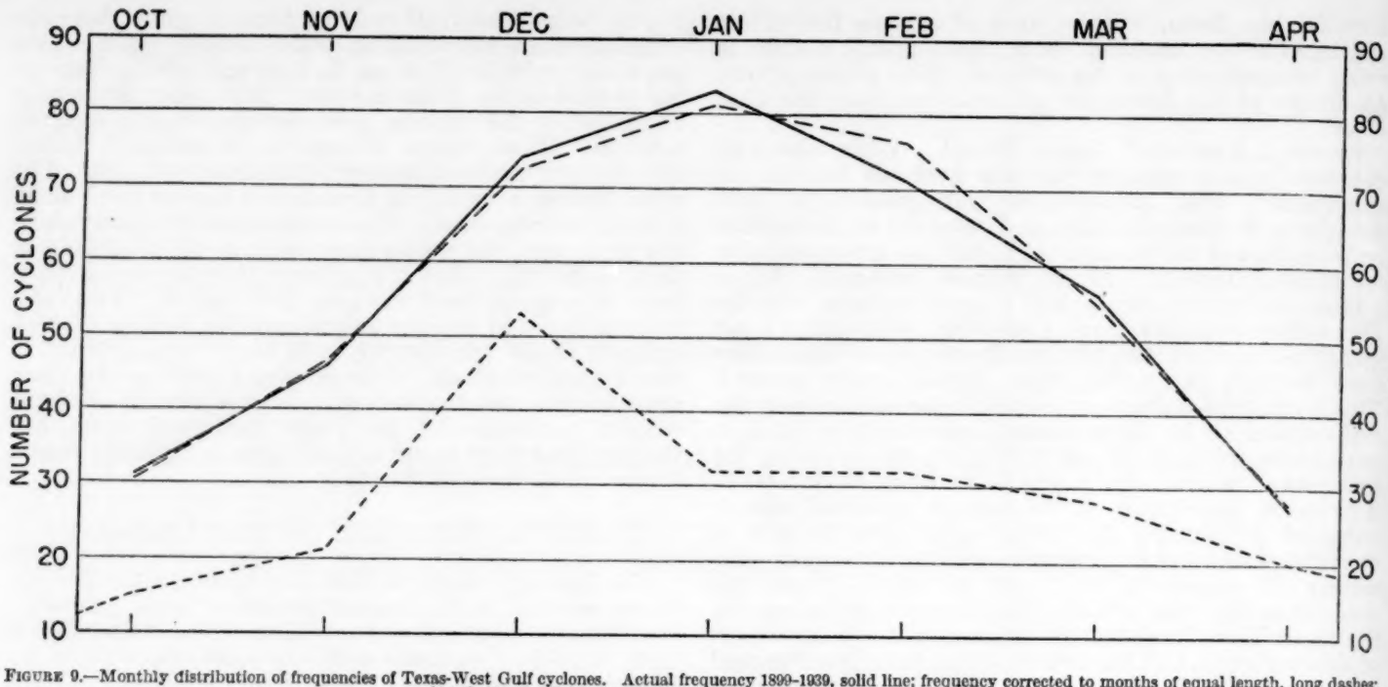

FIGURE 9.—Monthly distribution of frequencies of Texas-West Gulf cyclones. Actual frequency 1899–1939, solid line; frequency corrected to months of equal length, long dashes; distribution by Bowie and Weightman [1] for 1892–1912, short dashes.

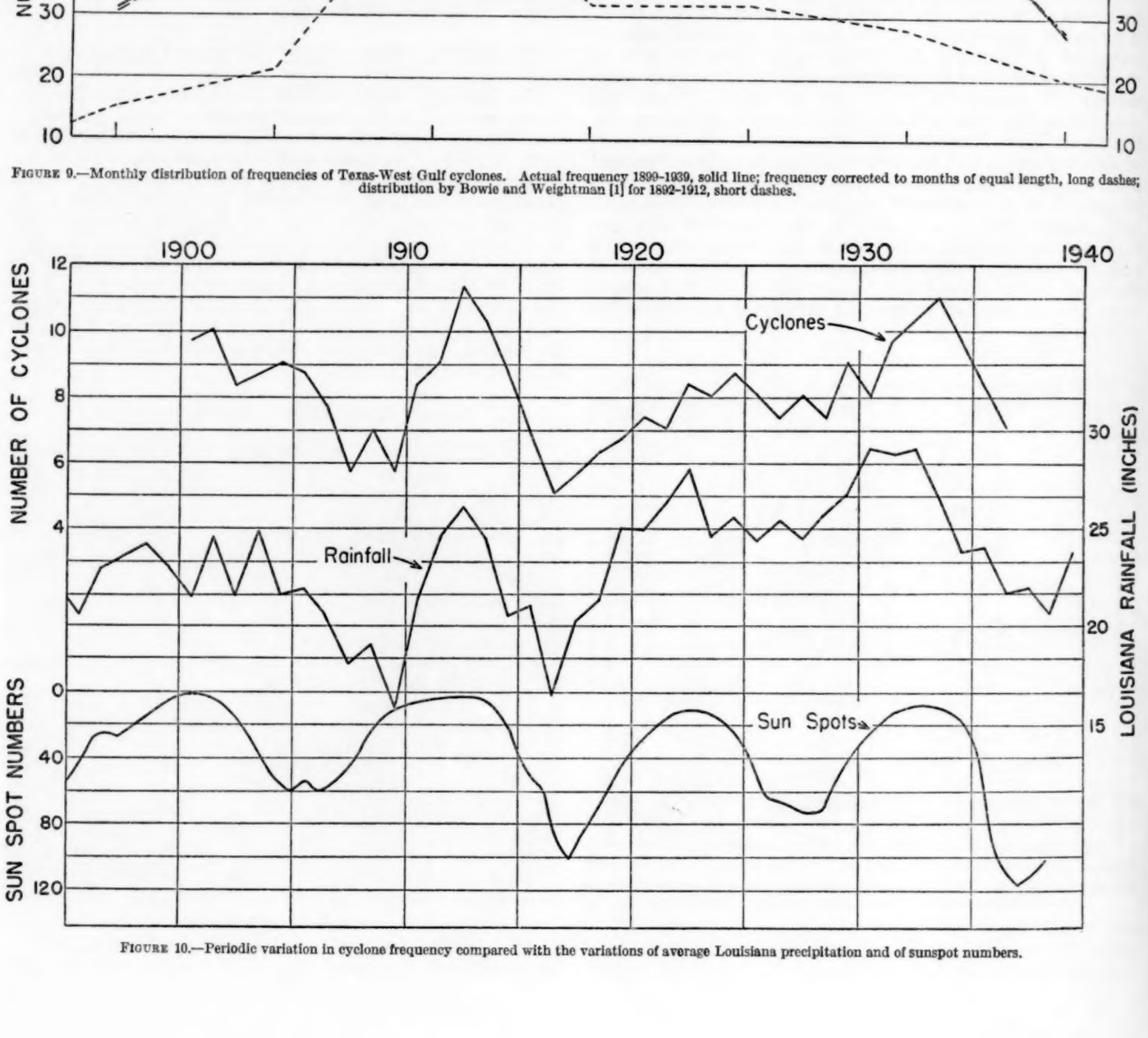

FIGURE 10.—Periodic variation in cyclone frequency compared with the variations of average Louisiana precipitation and of sunspot numbers.

INTERANNUAL VARIATION OF CYCLONE FREQUENCY

The average annual number of cyclones was slightly less than 10. The greatest annual number occurred in 1899 with 19 cases and the minimum in 1916, a relatively dry year, with only 2. The interannual variability was 3 cyclones, or about one-third of the average annual number.

For the analysis of the statistical material presented in the next few sections the seasonal period (October through April) instead of the annual period is considered. In the remainder of this section October and April are excluded.

The statistics on seasonal cyclone frequency indicate that periods of maximum and minimum activity tended to repeat themselves in a regular fashion. Part of this variation could be accounted for by inaccuracies in the selection of cyclones and to a lesser extent perhaps in the actual map analysis. However, such inaccuracies could just as well serve conversely to smooth out natural variations. A curve of the three-season-average cyclone frequency is shown in figure 10. The curve reveals regions of maxima and minima having periods of approximately 11 years. The climatic importance of this variation is evident from the great amplitude which is shown even after averaging. An inspection of the similarly smoothed curve of Louisiana rainfall for the same months as obtained from summary data in *Climatological Data for the United States by Sections* corroborates this cyclone variation. Periods of more frequent cyclogenetic activity near the Texas coast should *a priori* also be periods with larger amounts of precipitation over a flat area immediately to the northeast. The precipitation scale represents a variation from near-drought to flood conditions. The similarity of the two curves even in the unusual decade after 1920 is outstanding, although the linear correlation between cyclone number and inches of rainfall is rather small. A more detailed description of the relation of cyclones to rainfall follows in a later section.

A comparison of these variations with the more widely known variation of solar activity is afforded in figure 10 by the inverted form of Clayton's [8] sunspot curve. Again, the curves show variations of about equal length and good phase relations. Sunspots are generally considered to be correlated to solar radiation which in turn is a determining factor in the earth's atmospheric circulation.

LOCATION OF CYCLONE FORMATION

As a matter of convenience the site of first detection of each cyclone from daily charts was designated as the location of cyclogenesis. Since the cyclones normally move eastward, the exact point of origin would usually lie to the west of the assigned location.

The map presenting location of cyclone formation for the entire season October through April (fig. 11 (a)) shows a clustering of points which extends eastward from extreme southern Texas; this area coincides in location with the large surface temperature gradients for the season. An additional feature of the map is the scarcity of cyclones originating in western Texas; cyclones appearing over this region were usually observed to have moved in from the west near the Mexican border and could not all be included among those *forming* in the designated Texas-West Gulf area.

The clustering of points near the coast is even more

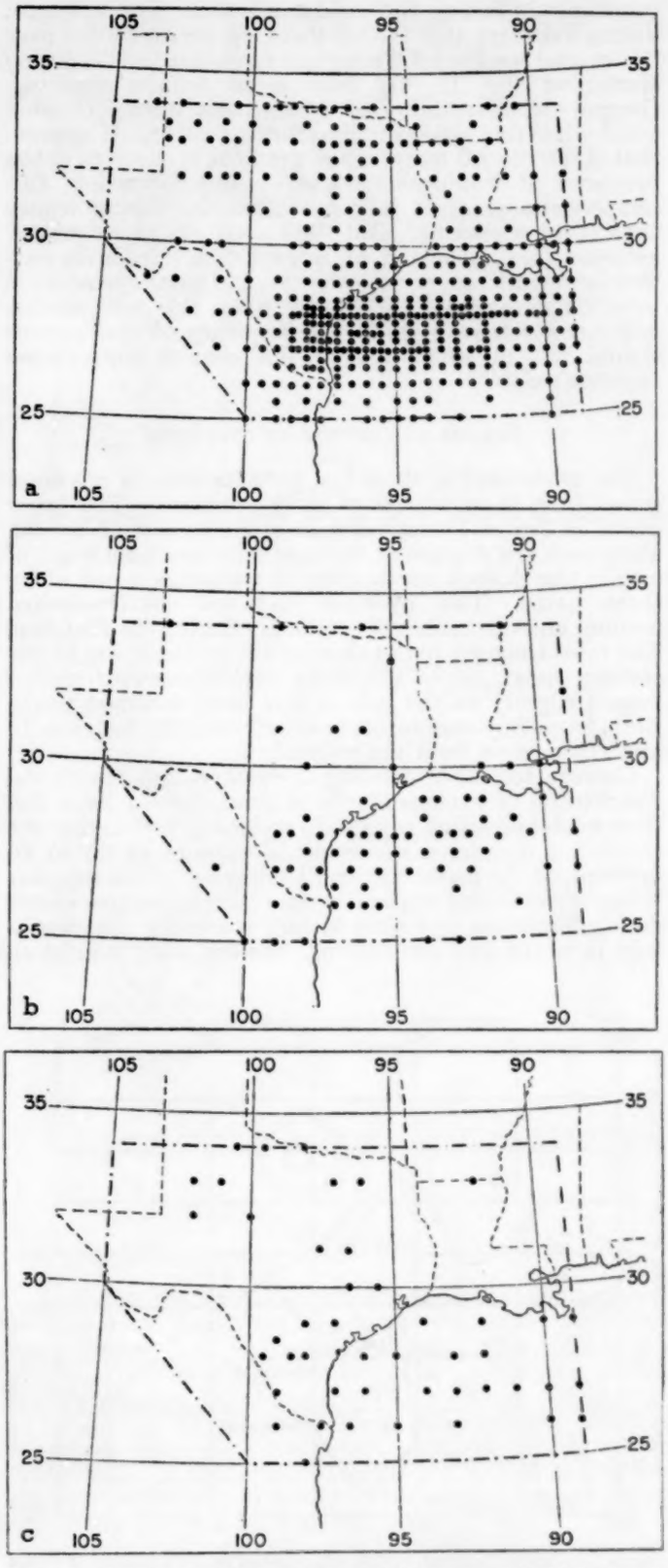

FIGURE 11.—Location of cyclone formation for (a) the seven months October through April, (b) February, and (c) November.

pronounced during the colder months. For example, during February (fig. 11 (b)) there is a concentration over the coastal waters off Texas and Louisiana, while during November (fig. 11 (c)) there is no definite grouping. Geographic distribution of cyclogenesis during October and April is very similar to that for November. It appears that if the coastal temperature gradient is effective in the processes of frontogenesis and cyclone formation, this temperature gradient is more influential during winter than in other seasons. But since there are many winter cyclones forming inland at some distance from the natural land-sea temperature contrast, and since cyclones are common in autumn and spring when this temperature contrast is relatively small, the frequency of cyclogenesis should not be attributed to this coastal temperature contrast only.

TRACKS AND SPEEDS OF CYCLONES

The movement of these low pressure centers was computed from their successive daily positions. The lower curve in figure 12 represents the frequency of motion along each ten degrees of compass direction from point of origin; the dashed curve gives the average speed along these paths. Two cyclones had net southwestward motion, and one remained stationary during the first day. The most frequent path taken by the cyclones was to the east-northeast, while the more rapidly moving storms moved slightly to the left of this most common track. Both frequency and speed drop off abruptly between 70 and 100 degrees from the origin.

During December, January, February, and March the distribution of cyclone tracks is characterized by a distinct modal direction toward 70 or 80 degrees; during the remaining months a minor mode appears at 30 to 40 degrees and the major one near 80 degrees. This suggests that the prevailing upper current over the surface center during formation and early history is usually west-southwest in winter and early spring. In the other months an upper flow of larger amplitude, providing a northward component in the motion of the cyclone, is often necessary. The cyclones which moved with a westward component occurred principally during autumn and spring in association with subtropical synoptic conditions similar to those described by Riehl [9] in which a warm anticyclone intensified over the eastern States.

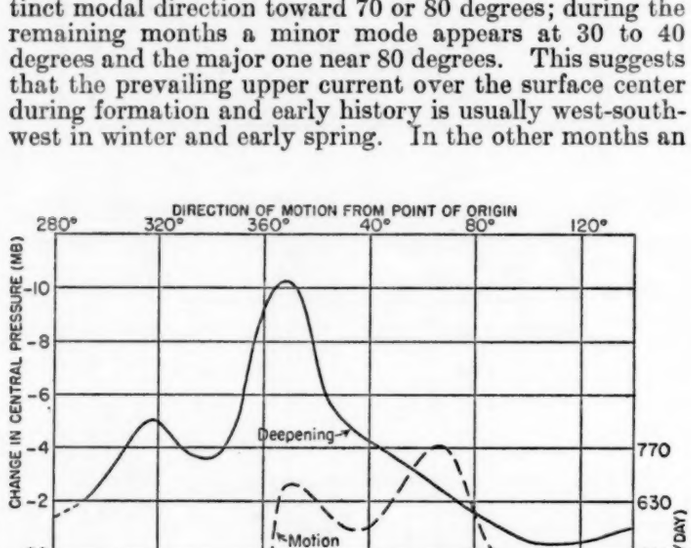

FIGURE 12.—Cyclone frequency, motion, and deepening for given direction of motion during the first day.

The cyclones move most slowly in October (table 1) when they average less than 400 miles per day. The average speed increases with the season, reaching more than 600 miles per day in January, and decreases very little from winter to spring. This lag in the distribution of average speeds is in agreement with the seasonal variation in the latitude of maximum zonal westerlies both at sea level and at 3 km. given by Willett [10]. During October, November, and April the smaller average displacement and the great tendency for movement toward northeast have the effect of minimizing the average displacement along the 30- and 40-degree tracks in figure 12; many rapidly moving storms follow these tracks in winter.

TABLE 1.—*Distribution of cyclone frequencies, motion, and deepening by months*

Month	Frequency	Average motion in first day (miles)	24-hr. change in central pressure (mb.)	
			First day	Second day
October	31	390	−2.2	−3.1
November	46	480	−3.4	−4.3
December	74	550	−3.6	−5.8
January	83	620	−1.9	−7.3
February	71	610	−2.3	−6.9
March	56	610	−3.9	−5.9
April	27	500	−2.3	−3.4
Total or average	388	570	−2.8	−5.8

DEEPENING OF CYCLONES

Statistics on the deepening of cyclones were obtained from daily estimates of the central sea level pressure of each cyclone. The final data are included in figure 12 and table 1.

Figure 12 shows that during the first day cyclones deepen most when moving northward, that is, when moving to the left of the most frequent and most rapid paths, and they show very little deepening when moving with a southward component. The cyclones moving along the principal track remain relatively weak during the first day. These are usually carried off with a strong upper current as stable frontal waves along the Gulf Coast and then deepen rapidly upon curving to the left over the Atlantic coastal region.

The seasonal trend in cyclone deepening undergoes an interesting cycle from October to April. An increase in deepening during autumn and a decrease during the spring months is to be expected. But there is a pronounced minimum in 1-day deepening during the coldest months (table 1), when the cyclones are most frequent and move most rapidly, when the westerlies are reaching their lowest latitude, and when the mean solenoid field along the coast is best developed. Again, average figures are very deceiving; many of the largest cyclonic developments take place during January and February. But there is also the tendency for small frontal waves to occur very frequently during these months. A computation of deepening during

the second day was made for each month of the season to determine if the *rates* of cyclone deepening showed any variation. Although several of the selected cyclones lost their identity after 1 day, those cases were sufficiently well distributed over the season so as not to seriously affect the results given in the last columns of table 1. It is apparent from the data that during the colder months, cyclones deepen at a rapidly increasing rate, in the first 48 hours of their history. When the 2-day period is considered there is no significant minimum in deepening during January and February even though those cyclones usually have a delayed development.

Considering all characteristics of the cyclones which have thus far been summarized, it can be stated that the typical winter cyclone forms south of the vicinity of Galveston, Tex., is found the following day south of the Appalachians near West Florida with only a slightly lower central pressure, and then deepens at an increasing rate while presumably curving northward in the Atlantic coastal region. For the autumn and spring no typical cyclone can be described because of the greater variations during these months.

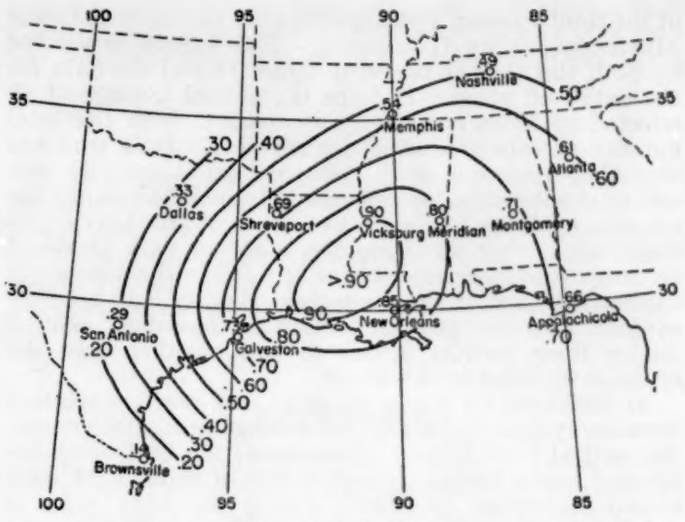

FIGURE 13.—Average 48-hour amount of rainfall (inches) associated with each cyclone during 11 seasons, November through March, 1928–1938.

PRECIPITATION ASSOCIATED WITH THE CYCLONES

In order to determine some relationship between the cyclones and the rainfall received in the land area most often affected by the cyclones, daily precipitation records from certain stations recorded in *Climatological Data for the United States by Sections* for the years 1928 through 1938 were analyzed. A 2-day interval embracing each cyclone formation was considered most suitable for all stations in the region (fig. 13). Since the daily synoptic charts were drawn for approximately 0700 local time (1300 GMT) and the rainfall period at each station was from midnight to midnight, the rainfall data cover the period beginning 7 hours before and ending 41 hours after the time assigned to each cyclone formation. All cyclones and stations were treated in this same manner, irrespective of location of formation, motion, or intensity. For this 11-year period the cyclones occurring during the months of October and April were not included in the analysis. A total of 95 storms occurred during the remaining months.

The average amount of rainfall during the 48-hour period (fig. 13) increases coastward and eastward to the Mississippi River; east of the Mississippi, where the storm tracks diverge greatly, the amount decreases more slowly. The average cyclone gives less rainfall in January and February than in the other months at Dallas, Shreveport, Vicksburg, Memphis, and Nashville; this points out the southward shift of cyclone tracks with the advance of winter and the northward shift in spring. In late winter the maximum rainfall per cyclone shifts eastward to the vicinity of Montgomery, toward the region with greatest late winter rainfall, although there is no distinct tendency for cyclones to form at a more easterly location at this time. This is probably related to the rate of deepening shown in table 1, to the predominant tracks south of Montgomery in this part of the season, and to the inevitable result of the spreading area of the cyclone with the resulting capacity for greater northward moisture transport as it moves eastward from the Texas-Louisiana coast.

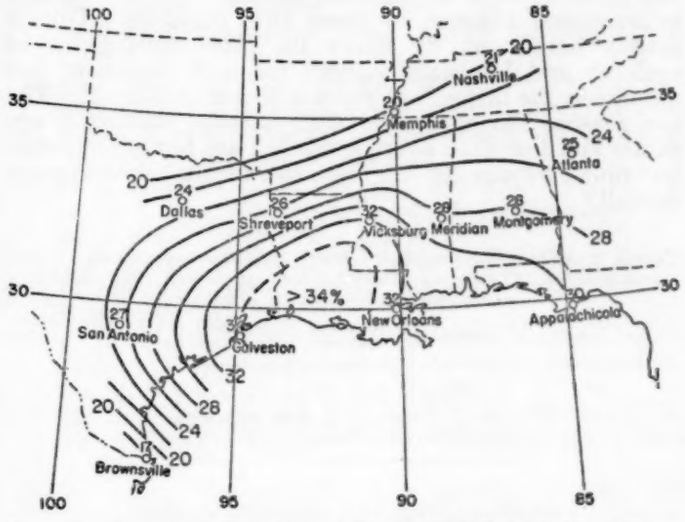

FIGURE 14.—Average percentage of the monthly rainfall attributed to the cyclones, November through March, 1928–1938.

As shown by figure 14 southern Louisiana and extreme southeastern Texas are the most dependent on these cyclones for their cold season rainfall. This reflects the great frequency and concentration of cyclogenesis immediately off the Texas coast. The seasonal distribution of the percentage of rainfall due to these cyclones shows a maximum in winter for all stations except Memphis and Nashville. At these places the effect is greater during the transitional months of spring and autumn when the storm tracks are nearer these stations.

An additional result obtained from the rainfall statistics is that the cyclones alone account for less than one-third

of the total seasonal precipitation over the extreme Lower Mississippi Valley (Louisiana). This feature is verified by both the 11-year period in figure 14 and the data for the entire 40 years. Perhaps the annual average of 10 selected cyclones is small in comparison with the total number of rain-producing disturbances. It is true not only that numerous small cyclonic circulations with rain areas did not persist long enough to be included among the selected cyclones but also that much of the heavy precipitation during these months occurred with transient storms. And large amounts of rain fell in the absence of surface cyclones in the immediate vicinity. It becomes evident that the greater portion of Louisiana rainfall during these months is due to factors other than the cyclones included in this study.

As indicated by figure 10 there is a positive relation between cyclone frequency and average precipitation over the central Gulf Coast. The correlation coefficient between cyclone frequency and inches of rainfall for each season November to March during the forty years is +0.3. The regression of cyclones on rainfall for the same period shows that about 70 percent of the rainfall must be attributed to other causes, the same conclusion reached from figure 14. But regardless of this apparently minor role cyclones have on the total rainfall, there are parallel interseasonal changes in these two variables. This is readily borne out by figure 10. The contingency of cyclones and Louisiana rainfall for each season of five months in the last eleven years is shown in table 2. The two seasons having greater than average number of cyclones and less than average rainfall are borderline; each had nine cyclones and less than two inches below average rainfall.

TABLE 2.—*Tetrachoric relation between cyclone occurrence and Louisiana rainfall, 11 seasons, November through March 1928 to 1938*

Rainfall	8 or fewer cyclones	9 or more cyclones
<25.07	5	2
>25.07	0	4

Average number of cyclones per season=8.6
Average rainfall per season=25.07 in.

STATISTICS ON THE CYCLONE GROUPS

The classification of cyclones into the groups described in the early sections of this paper was applied to the 388 cases to obtain some statistical features of each group. Since for most of the 40-year period only sea level charts were available, the sequences at the surface necessarily became of primary importance; the associated upper flow patterns and sequences were only indirectly determined. Each cyclone was placed in the group which most closely resembled its synoptic pattern and type of formation.

A frequency distribution for each group is given by months in table 3. The cyclones forming with the aid of the cut-off Southwest Low have a maximum frequency during mid-winter and a rather symmetrical distribution from October to April. However, there are irregular distributions in the two situations under which the cyclones form. During late winter, when the westerlies reach their minimum latitude and the polar front is semipermanent along the Gulf Coast, the first group is more frequent and the second group reaches a seasonal low. The second group has its peak during fall and early winter, and there appears to be a slight secondary maximum in the spring. Cyclones included in the third group are preferred during the colder months, as are most of the cyclones associated with the Great Plains trough. In the fourth group are the cyclones which form after rapid northward shift of the westerlies and abrupt trough development over the western Plains; these are at a minimum in late winter. The cyclones described by the fifth group are generally winter phenomena although there is no ready explanation for the frequencies in February and March.

The favored location for the formation of the first and third groups, which occur mostly in winter, is over the coastal waters of the Gulf of Mexico. The second group appears at scattered locations within the area, similar to the locations for November in figure 11. Cyclones of the fourth group are usually more continental; they are found mostly to the north and west of the other groups. Such cyclones are believed to be frequent also in the Oklahoma-Kansas region. They are the most independent of the coastline temperature fields. The last group is found only in the eastern half of the area; its frequency would probably increase east of the Mississippi River.

Cyclones associated with the Southwest Low generally follow a course between east-northeast and east, those in the first group following this course with greater regularity. Group 3 cyclones have the most variable tracks, yet comparatively few do not move toward the northeast quadrant. The last two groups move toward the northeast quadrant almost without exception. These cyclones show the greatest tendency to move between north and northeast from their origin.

On the average the most rapidly moving storms are Groups 5 and 4, respectively, and the most sluggish are Group 2. In probability of deepening the order is similar to the order of speed, that is, Groups 4 and 5 show the greatest one-day deepening while Group 2 shows the least. Although Group 4 cyclones usually have the most ill-defined frontal structure at the surface in their early stages and move very rapidly, they are the most susceptible to deepening.

TABLE 3.—*Distribution of cyclone groups by months, 1899 to 1938*

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Totals
Southwest Low	16	23	25	38	30	26	11	169
1. Low Latitude Westerlies	1	5	13	25	27	17	4	92
2. High Latitude Westerlies	15	18	12	13	3	9	7	77
Great Plains Trough	15	23	49	45	41	30	16	219
3. Retrograde and Miscellaneous	11	16	33	31	37	17	7	152
4. Discontinuous Redevelopment	4	4	13	10	2	5	9	47
5. Persistent Trough	0	3	3	4	2	8	0	20

SUMMARY

The great frequency with which surface cyclones emanate from the Texas-West Gulf coastal region can be accounted for by the unique physiography of the environment. In addition to control by the general circulation, frontogenesis and cyclogenesis in this region are favored by the influences of the warm-water surface of the Gulf of Mexico providing both a temperature contrast and moisture source, the cold continental air mass source region to the north, and the mountain barrier to the west. The frequency with which the polar front is in the vicinity of the north Gulf coast and the natural land-water temperature contrast in winter make the coast a semipermanent low-level frontal zone; in summer and in the region to the west this effect is almost negligible. The effect of the mountains on Texas cyclogenesis is both direct and indirect. A large number of these cyclones compensate for the relative absence of surface cyclogenesis between the Pacific Ocean and the Gulf of Mexico at the same latitudes; the upper level perturbations are carried eastward to the more favorable influences of the Gulf coastal region for surface cyclonic development. Also, the mountains aid dynamically in maintaining anticyclonic (or less cyclonic) curvature of air flow in the middle troposphere over western North America and cyclonic curvature east of the mountains. This effect is shown in the mean circulation and has been described by Fultz [11], by Namias and Clapp [12], and more recently by Boffi [13]. As a result of the increased southward component of motion over the Great Plains, cold air is steered farther southward and with greater frequency to the Gulf coast. As a western barrier to very cold masses of air spreading from Canada, the Rocky Mountain Range serves a similar effect in providing for northwest currents at upper levels. The surface lee-of-the-mountains warm trough in its basic sense is not considered to be an important forerunner in Texas cyclone formation.

From the description of several sequences and patterns in Texas cyclone formation it is possible to deduce the general synoptic principle involved. The four groups most typical of this region all involve a discontinuous westward shift in the location of maximum upper level cyclonic activity over North America; the other group (Group 5) can be viewed along the same lines since it consists of a marked retardation in the eastward progression of the primary trough with small short-period oscillations in trough position. Therefore, the cyclones are not associated with the primary southward push of cold air; they usually are found south and west of the preceding cold dome of the eastern states. The cyclones seldom occur immediately after a deep cold air mass has penetrated the southern extents of the Gulf of Mexico; they are most common when the bulk of the cold air at low levels is retained north of the Gulf coast.

The basic wave pattern of the westerlies from which the cyclones are to be anticipated consists of trough over eastern North America, ridge near the west coast, and trough over or just east of the central Pacific. Again, the last group of cyclones is different; its wave pattern has been described sufficiently. Very little definite information can be given on latitude, strength, and amplitude of the westerlies during cyclone formation because they vary not only with type of formation but also with individual cases.

ACKNOWLEDGMENT

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METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR AUGUST 1949

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during August 1949*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,005.1 mb.)				Albuquerque, N. Mex. (839.7 mb.)				Atlanta, Ga. (982.0 mb.)				Big Spring, Tex. (927.3 mb.)				Bismarck, N. Dak. (954.6 mb.)				Boise, Idaho (912.8 mb.)				Brownsville, Tex. (1,012.3 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	86	19.5	78	31	1,620	25.1	39	31	300	23.9	81	31	774	26.5	51	31	505	22.0	62	31	868	25.7	34	30	6	27.3	81
1,000	31	130	20.7	74	31	49	(*)	----	31	140	(*)	----	31	100	(*)	----	31	96	(*)	----	31	54	(*)	----	30	114	26.7	80
950	31	578	20.4	63	31	518	(*)	----	31	590	23.8	74	31	562	(*)	----	31	551	22.6	57	31	517	(*)	----	30	572	24.3	73
900	31	1,041	17.5	63	31	1,006	(*)	----	31	1,063	20.9	76	31	1,038	26.2	48	31	1,020	22.5	44	31	993	27.4	25	30	1,041	22.9	54
850	31	1,527	14.0	65	31	1,513	(*)	----	31	1,556	17.7	77	31	1,539	22.9	50	31	1,514	19.0	46	31	1,495	24.2	23	28	1,537	20.2	48
800	31	2,036	10.6	67	31	2,043	22.8	37	31	2,073	14.4	75	31	2,064	18.5	56	31	2,031	15.3	47	31	2,020	19.7	27	28	2,058	17.1	45
750	31	2,575	7.4	59	31	2,606	18.4	41	31	2,621	11.2	70	31	2,614	14.1	61	31	2,583	11.4	48	31	2,574	15.1	31	28	2,606	13.4	47
700	31	3,136	4.6	50	31	3,188	13.5	47	31	3,189	7.9	65	31	3,193	9.8	64	31	3,148	7.6	48	31	3,150	10.3	35	28	3,182	9.6	48
650	31	3,741	1.6	43	31	3,814	8.4	53	31	3,803	4.5	62	31	3,808	5.6	61	31	3,761	3.2	46	31	3,762	5.1	40	28	3,797	5.7	48
600	31	4,378	−1.7	34	31	4,462	3.0	61	31	4,446	1.0	57	31	4,456	1.6	56	31	4,399	−1.4	43	31	4,409	−.1	42	28	4,444	2.0	42
550	31	5,068	−5.9	----	31	5,165	−2.5	64	31	5,142	−2.7	48	31	5,154	−2.4	50	31	5,090	−6.1	43	31	5,099	−5.4	43	28	5,141	−2.0	38
500	31	5,806	−10.7	----	31	5,910	−7.5	61	31	5,891	−7.0	44	31	5,904	−6.7	44	30	5,825	−10.3	33	31	5,839	−10.9	46	27	5,891	−6.6	36
450	31	6,617	−15.8	----	31	6,734	−12.1	47	31	6,714	−12.0	44	31	6,727	−11.6	40	30	6,638	−16.1	35	31	6,647	−16.7	46	27	6,715	−11.6	33
400	31	7,486	−22.1	----	31	7,616	−17.8	38	31	7,598	−17.6	40	31	7,613	−17.9	38	29	7,501	−22.8	----	31	7,514	−22.8	----	27	7,600	−17.8	34
350	30	8,457	−28.8	----	31	8,600	−24.8	----	31	8,584	−24.3	----	31	8,598	−24.8	----	29	8,465	−30.2	----	29	8,479	−29.9	----	26	8,586	−24.8	----
300	29	9,541	−36.7	----	30	9,703	−33.4	----	31	9,688	−32.6	----	31	9,699	−33.2	----	29	9,543	−38.6	----	28	9,557	−38.0	----	25	9,687	−33.2	----
250	29	10,779	−45.9	----	29	10,957	−43.4	----	31	10,946	−42.5	----	31	10,955	−43.0	----	28	10,780	−47.5	----	28	10,788	−46.8	----	22	10,939	−43.2	----
200	29	12,233	−54.2	----	27	12,421	−54.5	----	31	12,415	−54.3	----	29	12,419	−54.1	----	27	12,226	−54.2	----	26	12,233	−53.9	----	20	12,401	−53.6	----
175	29	13,083	−57.3	----	23	13,267	−60.2	----	30	13,256	−60.5	----	26	13,273	−59.5	----	26	13,032	−56.0	----	21	13,090	−55.2	----	19	13,243	−59.2	----
150	29	14,049	−60.4	----	20	14,225	−65.4	----	29	14,204	−65.4	----	26	14,224	−64.8	----	24	14,061	−57.9	----	15	14,063	−57.2	----	14	14,207	−64.8	----
125	27	15,176	−62.0	----	12	15,333	−69.4	----	25	15,298	−68.9	----	24	15,328	−68.7	----	20	15,202	−60.2	----	10	15,234	−60.2	----	9	15,323	−70.2	----
100	22	16,558	−62.5	----	6	16,667	−70.5	----	18	16,630	−68.5	----	14	16,661	−69.0	----	11	16,589	−61.3	----								
80	15	17,939	−61.1	----					7	17,969	−65.0	----																
60	5	19,740	−56.6	----																								

Standard pressure surface (mb.)	Buffalo, N. Y. (990.5 mb.)				Camaguey, Cuba [1] (—— mb.)				Caribou, Maine (990.7 mb.)				Charleston, S. C.[2] (1,015.5 mb.)				Ciudad Victoria, Mex. 973.4 mb.)				Columbia, Mo. (987.4 mb.)				Dodge City, Kans. (925.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	221	20.1	75	----	----	----	----	31	191	15.8	84	17	13	24.2	93	26	335	30.2	50	31	239	22.9	78	31	792	23.7	61
1,000	31	137	(*)	----	----	----	----	----	31	110	(*)	----	31	136	24.7	88	26	91	(*)	----	31	128	(*)	----	31	108	(*)	----
950	31	588	20.6	59	----	----	----	----	31	552	17.2	66	31	590	23.4	79	26	552	28.3	51	31	579	23.8	65	31	565	(*)	----
900	31	1,049	17.6	60	----	----	----	----	31	1,010	14.5	64	31	1,059	20.7	74	26	1,030	24.1	55	31	1,049	20.4	66	31	1,039	24.7	54
850	31	1,535	14.2	61	----	----	----	----	31	1,491	11.2	67	31	1,551	17.7	71	26	1,528	19.9	61	31	1,541	17.2	62	31	1,538	21.4	56
800	31	2,044	10.8	62	----	----	----	----	31	1,994	7.9	67	31	2,069	14.6	68	26	2,048	15.8	66	31	2,056	14.2	57	31	2,060	17.7	58
750	31	2,582	7.9	49	----	----	----	----	31	2,529	4.7	66	31	2,619	11.7	64	26	2,595	12.0	66	31	2,605	10.9	57	31	2,611	14.2	57
700	31	3,146	5.0	45	----	----	----	----	31	3,084	2.1	58	31	3,188	8.5	62	26	3,168	8.4	62	31	3,171	8.0	46	31	3,188	10.2	55
650	31	3,754	2.1	41	----	----	----	----	31	3,681	−1.2	54	31	3,803	4.9	62	25	3,781	4.5	62	31	3,785	4.5	43	31	3,804	6.1	52
600	31	4,389	−1.2	36	----	----	----	----	31	4,314	−4.4	44	31	4,448	1.2	63	24	4,428	.7	55	31	4,426	.8	40	31	4,452	1.8	46
550	30	5,079	−5.6	----	----	----	----	----	30	4,998	−8.0	40	31	5,148	−1.2	58	23	5,121	−3.6	52	31	5,122	−3.5	41	31	5,148	−3.1	45
500	28	5,821	−10.3	----	----	----	----	----	30	5,731	−12.4	37	31	5,894	−6.9	55	21	5,871	−7.8	44	31	5,867	−8.0	39	31	5,896	−7.6	40
450	27	6,636	−15.5	----	----	----	----	----	29	6,534	−17.7	35	30	6,722	−11.9	50	20	6,698	−12.8	----	31	6,687	−13.5	36	31	6,715	−13.0	34
400	27	7,509	−21.9	----	----	----	----	----	29	7,402	−23.9	----	30	7,603	−17.3	49	19	7,574	−19.2	----	31	7,563	−19.9	----	30	7,597	−19.2	32
350	27	8,476	−29.3	----	----	----	----	----	29	8,362	−31.2	----	29	8,591	−24.0	----	17	8,554	−26.0	----	31	8,539	−27.1	----	30	8,577	−26.1	----
300	27	9,558	−37.4	----	----	----	----	----	27	9,431	−39.1	----	28	9,696	−32.0	----	16	9,653	−34.1	----	31	9,631	−35.5	----	29	9,672	−34.5	----
250	26	10,801	−46.6	----	----	----	----	----	27	10,660	−46.6	----	25	10,956	−42.0	----	15	10,903	−44.1	----	29	10,883	−44.1	----	29	10,921	−43.8	----
200	24	12,251	−54.6	----	----	----	----	----	27	12,119	−52.5	----	25	12,428	−54.0	----	12	12,372	−55.4	----	26	12,350	−52.6	----	28	12,388	−53.7	----
175	19	13,098	−57.9	----	----	----	----	----	27	12,978	−53.9	----	24	13,274	−60.1	----	12	13,211	−61.3	----	23	13,217	−56.8	----	28	13,236	−58.5	----
150	15	14,063	−60.2	----	----	----	----	----	23	13,967	−56.1	----	23	14,223	−65.7	----	11	14,149	−67.4	----	22	14,179	−61.8	----	28	14,191	−64.1	----
125	14	15,196	−62.7	----	----	----	----	----	20	15,139	−57.9	----	21	15,322	−69.1	----	6	15,248	−70.6	----	16	15,305	−65.0	----	24	15,297	−68.2	----
100	7	16,563	−62.0	----	----	----	----	----	18	16,546	−56.8	----	13	16,657	−68.3	----					14	16,644	−66.6	----	17	16,634	−67.4	----
80					----	----	----	----	7	17,973	−56.3	----	6	17,977	−66.7	----					6	18,012	−65.0	----	11	17,995	−64.9	----
60					----	----	----	----																	5	19,764	−60.4	----

Standard pressure surface (mb.)	El Paso, Tex. (881.7 mb.)				Ely, Nev. (810.5 mb.)				Glasgow, Mont. (938.1 mb.)				Grand Junction, Colo. (852.5 mb.)				Great Falls, Mont. (887.3 mb.)				Greensboro, N. C. (985.1 mb.)				Hatteras, N. C. (1,016.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	1,195	27.4	41	31	1,908	18.9	31	31	648	24.3	39	31	1,474	25.3	28	30	1,128	23.0	32	31	273	22.2	90	31	3	25.0	91
1,000	31	61	(*)	----	31	49	(*)	----	31	80	(*)	----	31	43	(*)	----	30	67	(*)	----	31	141	(*)	----	31	143	24.8	87
950	31	533	(*)	----	31	512	(*)	----	31	540	(*)	----	31	514	(*)	----	30	531	(*)	----	31	592	23.0	76	31	594	22.8	76
900	31	1,018	(*)	----	31	992	(*)	----	31	1,011	24.2	34	31	999	(*)	----	30	1,007	(*)	----	31	1,061	20.3	76	31	1,063	20.1	74
850	31	1,520	26.2	40	31	1,492	(*)	----	31	1,508	20.3	37	31	1,501	26.8	26	30	1,501	21.5	30	31	1,553	17.0	77	31	1,555	17.1	71
800	31	2,050	21.7	46	31	2,020	22.3	25	31	2,027	16.2	41	31	2,034	24.2	27	30	2,022	17.4	33	31	2,069	13.9	76	31	2,070	14.2	66
750	31	2,609	17.1	52	31	2,578	18.1	26	31	2,575	11.9	45	31	2,596	19.5	31	30	2,574	12.9	39	31	2,617	10.7	73	31	2,614	11.2	63
700	31	3,191	12.1	59	31	3,162	13.1	29	31	3,145	7.4	47	31	3,183	14.5	36	30	3,143	8.2	45	31	3,183	7.4	71	31	3,186	8.1	61
650	31	3,808	7.2	63	31	3,779	7.5	35	31	3,754	3.0	47	31	3,804	9.1	42	30	3,752	3.2	51	30	3,795	4.1	65	30	3,799	4.8	59
600	31	4,461	2.3	64	31	4,430	1.6	42	31	4,394	−2.0	48	31	4,459	3.3	49	30	4,392	−2.2	58	30	4,437	.5	57	29	4,447	1.0	59
550	31	5,160	−2.4	65	31	5,123	−4.4	50	30	5,075	−6.8	46	31	5,159	−2.5	56	30	5,077	−7.5	59	30	5,135	−3.0	52	29	5,143	−2.6	55
500	29	5,909	−7.0	60	31	5,868	−9.8	46	29	5,816	−11.9	40	31	5,906	−7.9	45	29	5,809	−12.6	47	30	5,881	−7.1	47	29	5,892	−7.1	53
450	29	6,734	−11.9	54	31	6,679	−15.0	36	29	6,618	−17.7	36	31	6,728	−13.0	36	29	6,614	−18.1	40	30	6,703	−12.2	44	29	6,715	−12.1	49
400	24	7,615	−17.8	----	31	7,554	−21.3	----	28	7,486	−24.1	----	30	7,607	−19.1	----	29	7,474	−24.8	----	29	7,585	−18.3	47	28	7,597	−17.9	47
350	22	8,604	−24.9	----	31	8,525	−28.3	----	28	8,446	−31.3	----	30	8,586	−26.0	----	29	8,430	−32.1	----	29	8,572	−25.1	----	26	8,583	−25.0	----
300	20	9,703	−33.7	----	31	9,613	−35.9	----	27	9,519	−39.7	----	30	9,683	−34.1	----	29	9,500	−40.3	----	29	9,670	−33.1	----	24	9,683	−33.3	----
250	18	10,955	−43.7	----	31	10,856	−45.0	----	25	10,737	−48.9	----	29	10,933	−43.4	----	29	10,718	−49.0	----	27	10,924	−42.6	----	23	10,938	−42.8	----
200	15	12,424	−55.0	----	31	12,317	−53.7	----	24	12,179	−54.6	----	27	12,402	−53.3	----	27	12,159	−54.9	----	26	12,395	−53.8	----	21	12,448	−54.1	----
175	11	13,273	−60.6	----	30	13,164	−57.5	----	24	13,032	−55.1	----	25	13,245	−58.2	----	26	13,099	−55.8	----	25	13,241	−59.4	----	16	13,250	−60.1	----
150	9	14,219	−66.2	----	29	14,124	−61.1	----	21	14,014	−57.2	----	22	14,204	−61.9	----	22	13,997	−57.2	----	18	14,199	−64.4	----	9	14,194	−64.3	----
125	5	15,294	−70.9	----	22	15,240	−65.1	----	18	15,161	−59.2	----	18	15,318	−65.1	----	16	15,152	−60.0	----	12	15,298	−66.6	----				
100					16	16,582	−65.2	----	11	16,556	−59.4	----	7	16,680	−64.5	----	10	16,551	−60.1	----	6	16,640	−65.8	----				
80					13	17,950	−62.0	----																				

See footnotes at end of table

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during August 1949*—Continued

Standard pressure surface (mb.)	Havana, Cuba [1] (—— mb.)				Honolulu, T. H. (1,015.8 mb.)				International Falls, Minn. (972.7 mb.)				Joliet, Ill. (995.3 mb.)				Lake Charles, La. (1,014.1 mb.)				Lander, Wyo. (830.9 mb.)				Las Vegas, Nev. (934.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	----	----	----	----	31	3	27.0	61	30	360	17.7	85	31	178	20.3	84	31	5	25.3	85	31	1,696	21.8	32	31	660	31.7	11
1,000	----	----	----	----	31	142	24.9	64	30	120	(*)	----	31	196	(*)	----	31	128	26.5	77	31	47	(*)	----	31	38	(*)	----
950	----	----	----	----	31	591	21.1	70	30	565	20.6	70	31	587	21.8	65	31	585	24.1	72	31	518	(*)	----	31	509	(*)	----
900	----	----	----	----	31	1,057	17.7	76	30	1,029	18.0	64	31	1,051	18.7	66	31	1,053	21.1	71	31	998	(*)	----	31	994	31.9	19
850	----	----	----	----	31	1,544	14.5	77	30	1,517	14.8	63	31	1,539	15.1	69	31	1,547	18.0	67	31	1,496	(*)	----	31	1,502	27.5	21
800	----	----	----	----	31	2,056	13.3	60	30	2,027	11.5	60	31	2,051	12.4	60	31	2,064	15.0	60	31	2,026	22.5	25	31	2,033	22.7	22
750	----	----	----	----	31	2,603	12.9	31	30	2,659	8.1	55	31	2,594	9.3	57	31	2,614	12.0	57	31	2,588	17.8	28	31	2,591	17.6	28
700	----	----	----	----	31	3,175	9.9	27	30	3,130	5.1	44	31	3,159	6.3	47	31	3,183	8.7	55	31	3,166	12.9	33	31	3,173	12.3	30
650	----	----	----	----	31	3,791	6.5	26	30	3,736	1.7	40	31	3,771	3.3	41	31	3,796	5.0	53	31	3,788	7.5	40	31	3,790	6.9	35
600	----	----	----	----	31	4,439	2.6	----	30	4,373	−2.0	38	31	4,409	−.4	36	31	4,442	1.3	47	31	4,436	1.9	48	31	4,441	2.0	33
550	----	----	----	----	31	5,134	−1.7	----	30	5,058	−6.6	40	31	5,102	−4.5	29	31	5,139	−2.8	42	31	5,131	−3.9	53	31	5,137	−2.7	34
500	----	----	----	----	31	5,888	−6.8	----	30	5,796	−11.5	36	31	5,843	−9.1	----	31	5,887	−7.4	40	31	5,876	−9.6	54	30	5,888	−7.6	----
450	----	----	----	----	31	6,706	−12.7	----	30	6,604	−16.8	33	31	6,656	−14.5	----	31	6,710	−12.4	39	31	6,692	−15.5	50	30	6,706	−13.3	----
400	----	----	----	----	31	7,591	−19.3	----	29	7,468	−23.1	----	31	7,532	−20.9	----	31	7,591	−18.4	35	31	7,560	−21.7	----	30	7,586	−19.9	----
350	----	----	----	----	31	8,569	−26.8	----	29	8,431	−30.3	----	31	8,505	−28.4	----	31	8,573	−25.5	----	30	8,527	−29.2	----	30	8,562	−26.9	----
300	----	----	----	----	31	9,663	−34.6	----	29	9,508	−38.6	----	31	9,590	−36.8	----	31	9,672	−33.9	----	30	9,610	−37.0	----	30	9,655	−35.1	----
250	----	----	----	----	30	10,913	−44.5	----	28	10,731	−47.6	----	31	10,828	−45.9	----	31	10,924	−43.7	----	30	10,848	−45.7	----	30	10,902	−44.2	----
200	----	----	----	----	30	12,370	−55.9	----	27	12,188	−53.7	----	31	12,284	−54.0	----	31	12,387	−54.7	----	29	12,304	−53.3	----	26	12,372	−54.0	----
175	----	----	----	----	29	13,209	−61.4	----	23	13,042	−54.3	----	31	13,134	−57.2	----	30	13,227	−60.5	----	28	13,157	−56.5	----	24	13,216	−58.7	----
150	----	----	----	----	27	14,158	−64.7	----	22	14,023	−56.3	----	28	14,098	−60.3	----	30	14,174	−65.9	----	28	14,126	−60.1	----	20	14,173	−63.4	----
125	----	----	----	----	25	15,263	−67.3	----	18	15,163	−57.5	----	24	15,228	−63.8	----	25	15,268	−69.9	----	25	15,253	−63.3	----	16	15,265	−66.8	----
100	----	----	----	----	20	16,602	−68.6	----	10	16,593	−60.0	----	22	16,593	−64.1	----	22	16,588	−70.1	----	15	16,626	−64.5	----	10	16,598	−67.0	----
80	----	----	----	----	13	17,945	−66.6	----	----	----	----	----	17	17,960	−61.6	----	14	17,930	−67.8	----	8	17,988	−62.6	----	----	----	----	----
60	----	----	----	----	9	19,710	−61.3	----	----	----	----	----	----	----	----	----	10	19,668	−62.8	----	----	----	----	----	----	----	----	----
50	----	----	----	----	9	20,848	−58.4	----	----	----	----	----	----	----	----	----	9	20,800	−60.8	----	----	----	----	----	----	----	----	----
40	----	----	----	----	9	22,262	−54.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
30	----	----	----	----	8	24,108	−51.7	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Little Rock, Ark. (1,005.7 mb.)				Mazatlan, Mex. (1,008.6 mb.)				Medford, Oreg. (967.8 mb.)				Merida, Mex. (1,011.4 mb.)				Miami, Fla. (1,016.1 mb.)				Nantucket, Mass. (1,014.3 mb.)				Nashville, Tenn. (995.1 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	79	24.7	82	31	14	29.8	74	31	401	23.7	38	31	27	27.2	76	31	4	26.5	82	30	14	19.5	92	31	177	23.3	84
1,000	31	129	25.2	78	31	91	29.1	75	31	112	(*)	----	31	128	26.9	75	31	146	26.3	79	30	137	20.5	83	31	134	(*)	----
950	31	586	24.7	66	31	553	25.6	79	31	566	22.9	39	31	580	25.2	71	31	600	24.0	76	30	583	19.7	66	31	585	23.1	73
900	31	1,054	21.3	70	31	1,023	23.3	76	31	1,030	19.3	45	31	1,056	21.9	73	31	1,070	21.2	73	30	1,045	17.1	64	31	1,054	20.0	73
850	31	1,547	17.9	69	31	1,521	20.5	73	31	1,519	15.3	52	31	1,550	18.6	74	31	1,563	18.3	68	30	1,531	14.3	61	31	1,545	16.8	73
800	31	2,064	14.8	65	31	2,043	17.8	65	31	2,029	11.2	59	31	2,069	15.2	73	31	2,081	15.2	64	30	2,041	11.4	59	31	2,060	13.8	68
750	31	2,613	11.8	62	31	2,599	14.9	57	31	2,571	7.9	58	31	2,615	12.1	68	31	2,626	12.1	60	30	2,581	8.4	58	31	2,606	10.8	68
700	31	3,182	8.3	62	31	3,175	11.0	59	31	3,132	5.3	45	31	3,190	9.0	61	31	3,201	8.7	57	30	3,145	5.4	53	31	3,175	7.2	64
650	31	3,796	4.7	61	31	3,791	6.6	66	31	3,732	1.0	41	31	3,804	5.7	54	31	3,814	5.3	52	30	3,750	2.2	48	31	3,786	3.7	62
600	31	4,440	1.2	56	30	4,442	2.1	66	31	4,372	−3.0	32	31	4,451	1.9	54	31	4,462	1.7	51	29	4,390	−1.3	41	31	4,428	.1	58
550	31	5,137	−2.7	50	28	5,140	−2.1	67	31	5,051	−6.9	28	31	5,147	−2.3	54	31	5,166	−2.2	47	29	5,078	−5.5	40	31	5,123	−3.7	54
500	31	5,886	−7.1	43	28	5,895	−6.5	61	31	5,793	−11.6	29	30	5,898	−6.7	54	31	5,910	−6.7	47	29	5,819	−10.0	----	31	5,868	−8.1	49
450	31	6,710	−12.3	40	28	6,721	−11.3	51	30	6,593	−17.3	----	30	6,720	−11.7	54	31	6,736	−11.7	43	27	6,629	−15.0	----	31	6,686	−13.1	43
400	31	7,590	−18.5	40	28	7,607	−17.1	47	30	7,464	−24.1	----	30	7,608	−17.5	52	30	7,619	−17.5	40	26	7,503	−20.8	----	31	7,567	−19.0	38
350	30	8,573	−25.1	----	26	8,593	−24.3	----	29	8,424	−31.5	----	29	8,591	−24.7	----	29	8,606	−24.0	----	25	8,479	−27.4	----	31	8,548	−25.8	----
300	30	9,675	−33.2	----	24	9,697	−32.6	----	29	9,497	−39.7	----	29	9,693	−33.1	----	28	9,712	−32.3	----	25	9,571	−35.2	----	31	9,646	−33.7	----
250	29	10,933	−42.4	----	23	10,956	−42.6	----	28	10,722	−48.0	----	27	10,948	−43.2	----	27	10,971	−42.0	----	24	10,819	−44.3	----	31	10,901	−42.6	----
200	28	12,410	−52.3	----	22	12,425	−54.3	----	27	12,173	−54.5	----	27	12,410	−55.3	----	24	12,446	−53.9	----	22	12,276	−54.0	----	31	12,372	−53.4	----
175	28	13,261	−57.5	----	22	13,268	−60.6	----	24	13,019	−55.9	----	27	13,249	−62.1	----	23	13,288	−60.3	----	22	13,124	−58.1	----	27	13,220	−59.5	----
150	27	14,222	−62.8	----	22	14,214	−66.8	----	17	13,980	−57.2	----	24	14,184	−69.3	----	19	14,236	−65.9	----	21	14,091	−61.4	----	18	14,183	−64.6	----
125	25	15,336	−67.3	----	20	15,299	−72.2	----	11	15,135	−59.0	----	19	15,258	−72.6	----	11	15,348	−70.5	----	16	15,225	−63.5	----	10	15,283	−68.6	----
100	23	16,676	−68.1	----	17	16,611	−74.2	----	----	----	----	----	12	16,574	−74.2	----	5	16,702	−72.9	----	9	16,576	−61.9	----	----	----	----	----
80	11	18,032	−64.3	----	8	17,934	−71.0	----	----	----	----	----	7	17,875	−71.4	----	----	----	----	----	----	----	----	----	----	----	----	----
60	----	----	----	----	6	19,670	−64.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
50	----	----	----	----	5	20,781	−61.7	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	New Orleans, La. (1,014.8 mb.)				North Platte, Nebr. (918.5 mb.)				Oakland, Calif. (1,014.9 mb.)				Oklahoma City, Okla. (969.5 mb.)				Omaha, Nebr. (979.7 mb.)				Phoenix, Ariz. (969.8 mb.)				Pittsburgh, Pa. (972.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	2	25.3	86	31	849	21.1	73	31	6	16.3	79	31	391	24.8	64	31	308	23.8	73	31	339	32.0	30	30	382	21.6	70
18,000	31	132	25.9	80	31	100	(*)	----	31	131	15.2	80	31	116	(*)	----	31	126	(*)	----	31	61	(*)	----	30	138	(*)	----
950	31	585	24.3	74	31	555	(*)	----	31	575	16.7	62	31	571	26.0	56	31	580	23.9	59	31	527	34.7	24	30	592	21.3	66
900	31	1,057	21.5	70	31	1,026	23.1	58	31	1,029	18.5	38	31	1,045	23.3	55	31	1,049	20.9	59	31	1,012	30.9	24	30	1,053	18.7	67
850	31	1,550	18.3	68	31	1,524	21.0	54	31	1,518	17.5	29	31	1,541	19.7	56	31	1,541	17.7	60	31	1,520	26.7	27	29	1,541	15.4	63
800	31	2,068	15.2	65	31	2,045	17.3	56	31	2,033	14.9	27	31	2,061	16.2	56	31	2,057	14.4	59	31	2,050	22.1	31	29	2,053	12.1	63
750	31	2,615	12.2	58	31	2,597	13.3	58	31	2,578	12.0	25	31	2,609	12.7	51	31	2,603	11.2	49	31	2,609	17.4	35	29	2,598	9.3	59
700	31	3,188	9.0	54	31	3,171	9.5	53	31	3,150	9.0	24	31	3,183	9.4	45	31	3,173	8.1	41	31	3,190	12.5	41	29	3,162	6.4	53
650	30	3,801	5.4	50	31	3,785	5.2	50	31	3,760	5.3	24	31	3,798	5.7	44	31	3,783	4.1	41	31	3,815	7.7	40	29	3,773	3.1	47
600	30	4,449	1.9	46	30	4,431	.7	51	31	4,408	1.1	25	31	4,445	1.5	44	31	4,427	−.2	45	31	4,460	3.1	40	28	4,409	−.3	38
550	30	5,145	−2.1	40	29	5,123	−4.2	47	31	5,102	−3.5	----	31	5,143	−2.7	43	31	5,119	−4.4	45	31	5,165	−1.7	40	28	5,101	−4.0	32
500	28	5,896	−6.9	39	29	5,868	−8.9	41	30	5,844	−8.9	----	31	5,890	−7.4	37	31	5,863	−8.9	38	31	5,911	−6.5	37	27	5,844	−8.8	29
450	26	6,716	−12.0	40	27	6,685	−14.0	----	30	6,655	−14.9	----	31	6,714	−12.6	33	31	6,679	−14.3	37	31	6,737	−11.4	31	27	6,662	−14.2	----
400	26	7,600	−17.7	42	27	7,559	−20.2	----	30	7,531	−21.6	----	30	7,590	−18.9	30	31	7,555	−20.8	----	30	7,620	−17.6	31	27	7,536	−20.6	----
350	23	8,582	−24.5	----	25	8,536	−27.8	----	30	8,499	−29.2	----	29	8,571	−25.9	----	31	8,527	−28.2	----	30	8,605	−24.9	----	27	8,510	−27.7	----
300	23	9,685	−32.7	----	25	9,624	−36.1	----	30	9,581	−37.4	----	29	9,667	−34.4	----	31	9,614	−36.7	----	30	9,707	−33.2	----	27	9,600	−35.7	----
250	22	10,949	−41.9	----	24	10,861	−45.4	----	30	10,816	−46.0	----	28	10,920	−43.5	----	30	10,855	−45.5	----	30	10,962	−42.9	----	23	10,865	−44.5	----
200	22	12,424	−53.1	----	24	12,317	−54.4	----	29	12,265	−54.0	----	25	12,377	−54.0	----	30	12,315	−53.8	----	29	12,425	−54.3	----	17	12,337	−53.9	----
175	21	13,270	−59.1	----	23	13,165	−58.8	----	28	13,111	−56.7	----	24	13,226	−58.8	----	30	13,165	−57.6	----	27	13,270	−60.0	----	15	13,192	−58.1	----
150	19	14,223	−65.0	----	21	14,119	−62.6	----	27	14,079	−59.5	----	23	14,182	−63.8	----	30	14,128	−61.7	----	26	14,222	−65.0	----	14	14,151	−61.7	----
125	14	15,318	−69.3	----	18	15,235	−65.9	----	26	15,208	−62.0	----	16	15,282	−67.5	----	30	15,246	−65.0	----	23	15,326	−69.4	----	13	15,266	−64.3	----
100	6	16,612	−69.4	----	16	16,588	−65.9	----	19	16,579	−61.8	----	11	16,636	−68.2	----	23	16,607	−65.3	----	15	16,658	−69.0	----	11	16,632	−64.4	----
80	----	----	----	----	13	17,953	−63.6	----	12	17,972	−60.6	----	6	18,002	−64.6	----	15	17,967	−62.8	----	7	17,998	−66.1	----	6	17,991	−61.6	----
60	----	----	----	----	----	----	----	----	7	19,780	−57.9	----	----	----	----	----	7	19,755	−59.2	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

TABLE 1,—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during August 1949*—Continued

Standard pressure surface (mb.)	Portland, Maine (1,012.6 mb.)				Rapid City, S. Dak. (903.3 mb.)				St. Cloud, Minn. (977.7 mb.)				San Antonio, Tex. (986.0 mb.)				San Juan, P. R. (1,014.5 mb.)				Santa Maria, Calif. (1,006.3 mb.)				Sault Ste. Marie, Mich. (990.4 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	20	18.3	84	31	980	22.0	45	31	317	20.6	78	31	240	26.3	69	31	15	26.4	83	31	71	14.9	83	31	221	16.1	85
1,000	31	128	20.4	72	31	78	(*)	----	31	120	(*)	----	31	115	(*)	----	31	143	25.9	82	31	124	14.5	83	31	137	(*)	----
950	31	574	19.7	59	31	540	(*)	----	31	573	22.1	64	31	575	26.7	60	31	599	22.8	84	31	573	18.0	61	31	581	17.8	66
900	31	1,035	16.8	61	31	1,012	(*)	----	31	1,036	19.7	62	31	1,046	23.6	62	31	1,064	19.8	81	31	1,026	20.8	35	31	1,038	15.8	62
850	31	1,520	13.4	64	31	1,512	23.1	35	31	1,526	16.5	61	31	1,543	20.1	65	31	1,556	17.2	73	31	1,518	19.3	32	31	1,522	12.7	62
800	31	2,028	10.0	66	31	2,037	19.3	39	31	2,040	13.5	53	31	2,063	16.6	63	31	2,072	14.8	62	31	2,037	16.3	33	31	2,029	10.0	57
750	31	2,568	6.9	60	31	2,592	14.9	43	31	2,586	10.2	50	31	2,612	13.1	62	31	2,623	12.0	53	31	2,589	13.6	----	31	2,568	7.6	46
700	31	3,125	3.9	57	31	3,168	10.5	46	31	3,152	6.9	44	31	3,188	9.7	54	31	3,192	8.6	52	31	3,159	10.3	----	31	3,128	4.3	49
650	31	3,729	.5	49	31	3,784	5.7	48	31	3,759	3.0	40	31	3,805	6.1	52	31	3,804	5.1	47	31	3,775	6.5	----	31	3,732	.7	45
600	31	4,364	−2.9	39	31	4,430	.6	51	31	4,400	−1.1	37	31	4,452	2.1	48	30	4,452	1.4	41	31	4,423	2.2	----	31	4,367	−2.9	36
550	30	5,052	−6.7	37	31	5,123	−4.6	49	31	5,091	−5.4	36	31	5,156	−1.9	43	29	5,150	−2.5	35	30	5,125	−2.2	----	31	5,053	−6.8	35
500	29	5,786	−11.3	34	31	5,866	−9.4	39	31	5,831	−10.1	----	29	5,902	−6.2	37	28	5,899	−6.7	32	30	5,874	−7.5	----	31	5,790	−11.3	----
450	29	6,593	−16.6	----	31	6,681	−14.7	----	31	6,642	−15.3	----	29	6,730	−11.6	33	27	6,720	−11.8	35	30	6,697	−13.3	----	31	6,598	−16.9	----
400	29	7,460	−22.8	----	31	7,554	−21.3	----	31	7,516	−21.5	----	29	7,611	−17.7	33	27	7,606	−17.9	----	30	7,571	−20.0	----	31	7,465	−22.9	----
350	29	8,424	−30.2	----	31	8,525	−28.6	----	30	8,483	−28.8	----	29	8,597	−24.5	----	27	8,590	−25.3	----	30	8,547	−27.1	----	30	8,430	−30.5	----
300	27	9,497	−38.2	----	31	9,610	−36.9	----	30	9,568	−37.2	----	29	9,701	−32.9	----	27	9,690	−33.9	----	28	9,637	−35.3	----	29	9,505	−39.0	----
250	26	10,744	−47.1	----	31	10,847	−45.7	----	29	10,801	−46.7	----	29	10,959	−42.6	----	26	10,942	−44.0	----	28	10,885	−43.8	----	28	10,728	−47.9	----
200	26	12,192	−55.1	----	29	12,306	−53.1	----	29	12,255	−53.4	----	26	12,430	−53.2	----	24	12,403	−55.8	----	25	12,366	−53.1	----	28	12,174	−54.3	----
175	24	13,044	−58.3	----	27	13,159	−56.3	----	28	13,122	−55.3	----	24	13,280	−58.4	----	24	13,241	−61.4	----	24	13,210	−57.8	----	24	13,031	−54.9	----
150	20	14,010	−60.9	----	25	14,132	−59.1	----	27	14,099	−57.7	----	20	14,238	−63.3	----	23	14,186	−66.5	----	23	14,173	−62.1	----	20	14,007	−56.9	----
125	16	15,131	−62.4	----	17	15,260	−62.2	----	27	15,241	−60.6	----	17	15,345	−67.5	----	20	15,276	−71.2	----	14	15,292	−65.1	----	18	15,154	−58.5	----
100	8	16,507	−60.1	----	8	16,628	−62.7	----	24	16,632	−62.0	----	11	16,683	−68.0	----	18	16,586	−74.4	----	6	16,662	−68.3	----	12	16,545	−59.5	----
80	----	----	----	----	----	----	----	----	16	18,020	−60.2	----	----	----	----	----	6	17,918	−72.9	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Spokane, Wash. (931.2 mb.)				Swan Island, W. I.[1] (.... mb.)				Tacubaya, Mex. (774.9 mb.)				Tampa, Fla. (1,015.5 mb.)				Tatoosh Island, Wash. (1,014.0 mb.)				Toledo, Ohio (993.7 mb.)				Washington, D. C. (1,013.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	721	23.5	31	----	----	----	----	30	2,306	16.5	68	31	9	25.5	87	31	31	13.5	91	31	191	20.9	81	31	25	24.1	78
1,000	31	92	(*)	----	----	----	----	----	30	68	(*)	----	31	145	25.5	82	31	148	13.5	88	31	135	(*)	----	31	144	24.2	71
950	31	549	(*)	----	----	----	----	----	30	530	(*)	----	31	594	23.0	80	31	587	12.7	74	31	585	21.3	65	31	594	22.0	67
900	31	1,018	22.4	31	----	----	----	----	30	1,009	(*)	----	31	1,067	20.4	77	31	1,033	11.0	66	31	1,048	18.2	67	31	1,060	18.7	69
850	31	1,511	18.1	34	----	----	----	----	30	1,506	(*)	----	31	1,559	17.5	74	31	1,508	8.4	66	31	1,536	14.9	65	31	1,549	15.8	68
800	31	2,025	13.5	40	----	----	----	----	30	2,035	(*)	----	31	2,076	14.6	70	31	2,007	5.6	65	31	2,047	12.0	57	31	2,062	12.7	65
750	31	2,570	9.1	41	----	----	----	----	30	2,589	14.8	66	31	2,623	11.5	67	31	2,538	3.0	57	31	2,590	9.3	50	31	2,605	9.7	60
700	31	3,132	5.1	42	----	----	----	----	30	3,165	10.5	71	31	3,195	8.3	63	30	3,088	.2	52	31	3,155	6.2	45	31	3,172	6.8	53
650	31	3,735	.9	40	----	----	----	----	30	3,783	6.1	78	30	3,806	4.7	62	30	3,683	−3.0	48	31	3,763	2.9	40	31	3,783	3.6	47
600	31	4,371	−3.5	40	----	----	----	----	30	4,431	1.7	82	30	4,453	.9	63	30	4,308	−6.7	46	31	4,402	−.8	41	31	4,424	.1	46
550	31	5,054	−8.2	43	----	----	----	----	28	5,130	−3.0	80	30	5,148	−2.9	59	29	4,989	−10.9	43	31	5,095	−4.5	31	31	5,120	−3.6	39
500	31	5,786	−13.2	42	----	----	----	----	28	5,879	−6.9	63	30	5,897	−7.0	54	29	5,711	−15.8	38	30	5,837	−9.2	----	31	5,864	−8.2	37
450	30	6,584	−19.2	45	----	----	----	----	28	6,706	−11.4	54	30	6,723	−11.8	53	29	6,502	−21.2	----	30	6,652	−14.9	----	30	6,683	−13.5	----
400	30	7,442	−25.6	----	----	----	----	----	28	7,590	−17.3	52	30	7,605	−17.5	51	28	7,355	−27.3	----	29	7,523	−21.3	----	30	7,560	−19.6	----
350	30	8,396	−32.9	----	----	----	----	----	28	8,577	−24.5	----	29	8,593	−24.6	----	28	8,302	−34.3	----	29	8,494	−28.3	----	29	8,539	−26.5	----
300	29	9,461	−40.7	----	----	----	----	----	28	9,680	−33.2	----	28	9,695	−33.2	----	28	9,363	−41.5	----	29	9,579	−36.7	----	28	9,632	−34.5	----
250	28	10,686	−48.7	----	----	----	----	----	28	10,935	−43.4	----	27	10,947	−43.5	----	25	10,578	−48.4	----	29	10,816	−46.0	----	28	10,881	−43.8	----
200	27	12,136	−53.1	----	----	----	----	----	24	12,403	−55.5	----	24	12,406	−55.7	----	22	12,024	−51.2	----	28	12,265	−54.8	----	27	12,349	−54.1	----
175	24	12,999	−53.1	----	----	----	----	----	20	13,244	−62.0	----	22	13,247	−62.0	----	21	12,894	−51.2	----	27	13,113	−58.0	----	26	13,195	−59.1	----
150	20	13,999	−54.6	----	----	----	----	----	13	14,188	−67.9	----	20	14,184	−67.5	----	15	13,882	−50.9	----	27	14,076	−61.2	----	26	14,150	−63.5	----
125	12	15,175	−56.9	----	----	----	----	----	5	15,328	−74.7	----	15	15,271	−72.1	----	8	15,056	−51.5	----	23	15,202	−64.6	----	23	15,258	−65.2	----
100	----	----	----	----	----	----	----	----	----	----	----	----	8	16,582	−71.0	----	----	----	----	----	13	16,563	−66.1	----	20	16,619	−65.2	----
80	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	9	17,937	−63.1	----	11	17,971	−62.1	----
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	6	19,740	−58.6	----	5	19,760	−58.1	----

[1] Data not yet received.

[2] Elevation changed from 13 meters to 18 meters on Aug. 17, 1949.

*Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T., except at Ciudad Victoria, Mazatlan, and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C. Relative humidity data beginning with Oct. 1, 1948, were computed, and expressed in these tables, on the basis of vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C. have formerly been computed and expressed on the basis of the vapor pressure over ice. All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

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DELAYED REPORT FOR JULY 1949

TABLE 1

Standard pressure surface (mb.)	Swan Island, W. I. (1,013.5 mb.)				Standard pressure surface (mb.)	Swan Island, W. I. (1,013.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity		Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	10	26.7	82	450	30	6,708	−11.9	28
1,000	31	129	26.0	83	400	30	7,598	−17.8	24
950	31	584	23.0	85	350	29	8,583	−24.7	----
900	31	1,051	20.3	78	300	29	9,685	−33.1	----
850	31	1,544	17.7	72	250	29	10,943	−43.3	----
800	31	2,061	15.1	61	200	29	12,401	−55.2	----
750	31	2,607	12.5	52	175	29	13,240	−61.9	----
700	31	3,123	9.1	49	150	29	14,172	−68.1	----
650	31	3,789	5.4	49	125	25	15,262	−72.1	----
600	30	4,444	1.4	46	100	18	16,581	−72.4	----
550	30	5,135	−2.5	42	80	9	17,901	−70.2	----
500	30	5,891	−6.9	40	60	6	19,640	−63.9	----

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T. during August 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (868 m.)			Brownsville, Tex. (7 m.)			Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	119	2.1	31	262	1.5	29	180	0.8	31	94	1.0	30	190	0.8	31	322	3.6	31	128	5.7	31	256	2.4	30	346	0.6	29	188	2.9	31	326	0.9	31	33	0.5	31	178	1.9
500							29	217	.5										31	139	7.3	31	253	3.5	30	278	1.2	29	199	4.5	31	331	.9						
1,000	31	123	2.1				29	225	.5				30	194	.8	31	322	3.2	30	151	5.4	30	260	4.6	30	283	2.6	28	214	4.5	31	306	.8						
1,500	31	149	1.7				27	283	.5	31	118	.9	30	221	1.2	31	339	1.6	29	159	3.0	30	252	4.7	30	281	4.5	26	232	3.5	31	260	.9				31	179	1.8
2,000	30	161	1.0	31	245	2.1	26	285	1.3	31	175	1.0	30	234	2.4	31	261	1.4	27	166	2.1	28	256	4.7	26	277	6.0	24	236	4.0	29	260	1.9	31	13	1.3	31	175	1.4
2,500	30	250	.7	31	227	2.2	24	299	2.1	31	216	1.7	30	269	4.1	31	224	3.0	26	176	1.2	27	261	5.5	25	281	7.8	23	236	3.9	26	259	2.6	31	36	1.1	31	114	.8
3,000	28	330	1.1	31	227	1.6	23	287	2.6	30	239	3.2	30	277	4.9	31	215	4.9	25	40	.3	27	271	6.9	24	282	9.2	21	242	3.8	23	278	2.6	31	60	.7	31	49	1.1
4,000	24	355	3.4	31	288	1.9	19	270	4.3	30	253	5.9	29	274	6.3	31	218	8.1	22	67	.9	22	278	7.7	18	293	11.8	18	234	4.2	17	306	1.1	29	290	2.4	27	22	1.9
5,000	16	343	5.1	31	292	2.1	14	263	5.7	27	262	9.4	25	274	8.2	28	222	11.2	20	73	1.2	20	278	9.4	14	298	13.2	15	243	4.4	13	314	2.3	23	284	5.2	24	38	2.3
6,000	12	345	6.0	26	281	2.5	10	285	6.0	26	264	11.4	21	272	9.0	24	226	11.7	18	69	.8	17	273	10.9				10	212	5.5	10	266	3.2	17	286	7.1	18	15	4.3
8,000				22	278	3.4				20	261	14.1	14	263	12.3	19	230	13.9	10	112	.5	12	289	16.3										12	288	10.0	14	352	5.4
10,000				18	286	7.2																																

	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (663 m.)			Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (12 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	188	4.1	31	259	1.2	28	180	0.0	31	45	0.4	26	146	2.3	31	209	1.1	31	198	2.5	31	135	0.5	31	303	2.0	29	132	2.9	31	209	0.9	30	324	0.9	31	157	1.6
500							28	315	.1				26	177	3.4	31	221	.7				31	34	.1	31	311	2.3	29	143	3.5	31	255	1.0	30	333	1.2	31	202	2.4
1,000							26	239	1.5	31	277	.5	26	205	2.6	31	273	1.3	31	192	3.6	29	288	.9	31	317	2.6	28	159	3.0	29	298	.9	29	280	.8	30	267	3.2
1,500				31	270	1.8	25	261	2.4	31	221	.9	25	219	2.7	29	273	2.4	31	196	3.7	28	294	1.2	31	272	2.1	28	161	2.2	26	346	1.5	29	275	1.7	28	279	3.9
2,000	31	193	4.4	31	282	2.2	25	270	2.4	31	235	1.8	21	221	1.6	26	295	2.6	31	199	4.7	25	285	2.1	31	222	4.1	26	162	1.9	20	258	1.2	27	271	2.0	22	284	4.6
2,500	31	209	4.5	31	263	2.0	22	288	2.7	31	234	3.6	21	243	1.7	22	295	3.4	31	203	5.4	24	267	1.7	30	207	5.4	24	173	2.7	13	357	1.5	25	276	2.5	21	290	5.7
3,000	31	199	4.7	31	249	2.2	21	296	2.9	30	244	5.0	19	251	2.6	21	296	3.8	31	213	6.4	22	299	1.7	30	207	6.6	23	169	2.6	12	275	.9	24	276	3.3	21	286	5.8
4,000	30	206	5.2	31	231	3.7	19	277	3.8	27	250	8.5	12	244	2.5	19	298	3.9	30	217	6.5	14	277	4.2	29	219	8.0	22	176	3.5				23	274	4.6	13	287	5.1
5,000	29	211	6.7	31	235	5.0	18	275	4.8	25	252	10.5				15	307	4.3	29	221	7.9	11	277	4.7	28	228	10.1	16	165	3.1				20	262	5.4	11	278	5.6
6 000	23	224	7.7	24	249	5.4	18	284	6.6	20	255	13.6							28	230	9.3				28	226	12.4	15	157	3.1				17	256	6.8			
8 000	15	244	12.8	21	268	7.7	10	268	9.2										25	229	11.6				22	233	17.3							10	246	10.7			
10,000	10	259	20.0																14	233	16.5				10	239	15.2												

	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Cloud, Minn. (318 m.)			St. Louis, Mo. (181 m.)			San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	267	5.6	31	124	2.1	31	159	1.2	31	232	1.2	31	39	0.9	31	231	1.3	31	19	0.7	30	134	2.0	31	279	3.7	20	267	2.3	31	248	2.2	31	222	1.9	31	80	0.4
500	30	268	3.8	31	124	2.1	31	170	1.8	31	230	1.6				31	216	1.6	31	24	1.3	30	121	2.3	31	279	2.6	30	271	3.1	31	248	2.5				31	243	.6
1,000	29	260	3.2	31	139	1.2	30	188	2.3	31	227	2.3	31	42	.8	30	218	2.6	31	352	1.2	30	115	2.1	30	283	1.3	29	274	2.6	29	231	2.7	31	217	2.5	30	256	.9
1,500	29	243	2.6	31	173	1.1	30	213	2.3	31	231	2.5	31	114	.3	28	229	3.6	30	331	1.9	30	102	1.5	30	273	1.3	28	280	3.0	27	210	3.3	31	217	2.8	30	260	1.6
2,000	29	228	2.9	31	275	.7	30	244	2.9	31	231	2.7	31	298	1.2	27	253	4.9	30	312	2.0	30	83	1.1	30	248	2.2	28	283	4.4	27	200	4.1	31	213	3.6	27	266	2.9
2,500	28	232	3.8	30	320	1.5	30	271	2.9	31	235	3.1	31	279	2.9	25	272	6.2	29	296	2.2	30	65	1.5	30	230	3.5	22	298	4.0	22	213	5.1	31	215	5.2	25	267	3.7
3,000	27	230	4.8	28	321	3.4	27	314	2.3	31	225	4.1	31	280	3.2	25	276	6.9	26	312	3.1	28	20	1.4	30	221	4.3	21	305	5.3	18	216	6.5	30	218	7.2	24	263	3.8
4,000	27	230	6.6	25	327	3.7	22	312	4.3	31	210	3.5	29	278	6.2	22	294	6.9	21	321	3.6	27	38	1.7	30	215	5.3	16	307	6.3	16	227	8.3	28	226	9.5	22	264	5.0
5,000	26	226	8.1	23	326	5.4	21	314	5.8	29	202	3.8	20	285	8.3	19	300	8.4	15	319	4.6	22	4	1.4	28	205	6.5	15	302	7.9	12	235	8.8	24	227	12.7	16	287	3.0
6,000	26	229	9.8	18	309	4.9	19	317	8.0	28	209	4.9	17	276	9.2	13	292	6.7	14	312	3.6	16	37	1.3	26	205	7.6	11	297	9.5	10	243	9.6	23	231	14.0	13	280	4.7
8,000	18	231	13.1	13	348	10.2	15	325	9.7	16	250	2.6	12	257	10.9							12	19	6.0	22	222	9.8							13	236	16.0			
10,000	12	231	19.0				10	329	15.6	10	280	1.8													16	224	13.5												
12,000																									11	234	19.9												

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T. during August 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second.*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.)			Big Spring, Tex. (774 m.)			Bismarck, N. Dak. (505 m.)			Brownsville, Tex. (7 m.)			Caribou, Maine (191 m.)			Charleston, S. C. (13 m.)			Columbia, Mo. (237 m.)			Grand Junction, Colo. (1,473 m.)			Greensboro, N. C. (275 m.)			Hatteras, N. C. (3 m.)			International Falls, Minn. (358 m.)			Little Rock, Ark. (80 m.)			Medford, Oreg. (401 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	143	2.4	31	138	3.1	31	74	2.3	31	132	3.8	31	268	1.6	31	188	0.9	31	97	1.5	31	39	0.2	31	153	0.5	31	210	1.7	31	176	1.0	31	172	0.5	31	325	4.8
500										31	138	7.8	31	273	4.4	31	213	4.3	31	126	2.0				30	185	1.6	31	208	4.1	31	202	2.2	30	129	1.9	31	325	5.3
1,000				31	152	5.0	30	93	3.0	31	132	5.3	31	280	6.2	30	213	4.3	31	123	1.9				29	206	2.2	31	216	4.0	31	244	2.6	30	121	1.1	31	320	6.0
1,500				31	156	5.6	30	155	.8	31	119	3.0	31	280	7.4	30	218	4.7	31	133	1.2	31	31	.2	29	218	1.9	31	225	3.8	31	286	2.8	30	162	.2	31	304	4.3
2,000	30	179	3.3	31	151	4.5	30	277	1.2	31	85	1.5	29	288	8.1	30	214	3.8	31	90	.1	31	236	.8	29	220	1.8	30	239	3.4	31	298	3.7	31	307	.2	31	269	2.7
2,500	30	194	2.5	31	149	3.0	30	289	2.7	31	111	.4	29	289	9.1	29	228	3.8	31	346	1.2	31	237	1.1	29	223	2.0	30	247	3.6	31	297	4.5	31	340	.7	31	227	4.5
3,000	30	209	1.6	31	128	1.3	30	289	4.3	30	77	.3	28	281	9.5	29	231	4.5	31	353	1.8	31	250	1.6	30	223	2.6	29	241	4.3	31	302	5.7	30	313	1.7	31	206	7.2
4,000	30	332	2.0	31	16	3.8	31	288	6.2	30	192	.3	28	277	11.3	29	233	4.5	31	1	2.5	31	261	2.4	28	238	3.2	26	242	4.9	29	292	7.4	30	307	2.2	31	213	8.6
5,000	31	338	3.9	31	18	4.2	31	291	7.8	30	51	.7	27	275	13.6	28	230	4.5	31	330	3.3	31	233	3.8	29	242	4.4	25	250	5.0	29	295	9.8	30	304	3.1	31	226	10.0
6,000	31	319	3.6	31	22	5.0	30	286	10.4	30	29	1.2	26	274	16.1	28	234	4.5	31	331	3.6	31	256	5.6	29	259	5.5	24	249	3.5	29	289	11.2	30	297	3.3	30	228	12.8
8,000	31	305	3.9	31	19	4.9	27	279	12.4	28	347	2.8	26	271	20.0	25	245	5.6	31	308	6.2	30	255	9.2	29	268	9.1	22	276	4.1	29	292	13.9	28	268	6.7	28	232	16.6
10,000	30	293	6.4	31	359	5.5	26	269	15.0	24	351	3.6	22	268	24.2	24	250	6.4	31	302	7.2	28	262	14.6	28	257	13.1	20	266	8.3	27	291	17.6	26	266	8.8	23	232	21.1
12,000	27	285	6.5	29	1	6.8	26	265	19.3	21	340	2.9	20	267	27.3	21	247	7.2	26	276	10.2	23	258	14.9	27	251	16.2	18	286	11.5	21	286	18.3	23	234	11.2	15	233	27.3
14,000	18	305	5.2	25	29	4.8	22	268	16.1	13	36	3.0	15	273	23.0	20	256	4.5	18	270	9.1	18	268	10.3	19	264	13.0	10	286	8.6	16	289	18.2	19	236	8.8			
16,000				14	47	5.6	16	260	10.7				11	274	22.4	15	207	1.8	10	319	4.3													14	242	2.0			

Altitude (meters) m. s. l.	Miami, Fla. (12 m.)			Nantucket, Mass. (14 m.)			Nashville, Tenn. (180 m.)			New Orleans, La. (6 m.)			Oakland Calif. (8 m.)			Oklahoma City, Okla. (392 m.)			Rapid City, S. Dak. (980 m.)			San Antonio, Tex. (242 m.)			San Juan P. R. (28 m.)			St. Cloud, Minn. (318 m.)			Santa Maria, Calif. (72 m.)			Sault Ste. Marie, Mich. (221 m.)			Spokane, Wash. (726 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	150	0.8	31	201	1.0	31	270	0.3	31	237	0.7	31	268	5.1	31	115	3.1	21	115	1.3	31	97	2.8	31	102	3.4	31	145	0.9	31	270	3.4	31	321	0.4	31	230	1.2
500	31	153	2.7	31	256	4.0	31	70	.9	31	301	.4	31	278	5.0	29	125	4.0				31	129	5.2	30	90	8.1	31	163	1.9	31	314	3.5	31	281	1.3			
1,000	31	162	2.5	31	272	3.7	31	110	.8	31	19	.8	31	266	5.1	29	150	4.2	31	120	1.3	31	142	4.8	30	91	8.2	31	212	3.4	31	333	3.1	31	269	2.6	31	240	2.0
1,500	31	157	2.5	31	278	4.3	21	114	.3	31	47	1.8	31	249	3.3	29	169	2.1	31	150	2.4	31	157	2.4	30	94	8.3	31	239	3.7	31	40	1.7	31	280	3.5	31	250	2.5
2,000	31	161	2.8	31	279	5.0	31	241	.7	31	54	1.5	31	231	2.8	30	252	1.1	31	185	1.8	31	96	1.0	30	95	8.3	31	268	3.3	31	115	1.4	31	290	4.2	31	239	3.7
2,500	31	168	2.9	31	272	6.0	31	240	1.2	30	80	1.4	31	227	3.1	30	323	2.1	31	236	1.6	30	28	1.7	30	93	8.0	30	287	3.6	31	184	2.0	31	294	5.5	31	229	5.6
3,000	31	172	2.8	31	270	6.5	31	256	1.7	30	121	1.0	31	220	3.9	30	341	3.9	31	275	3.7	29	14	2.6	30	100	7.8	30	279	4.1	31	220	3.2	31	294	6.3	31	228	7.9
4,000	31	157	2.6	31	267	8.9	31	260	2.0	30	254	.9	31	226	5.3	31	350	4.9	31	299	7.1	28	25	3.2	29	96	7.9	30	288	5.1	31	234	5.5	30	292	7.7	30	231	10.7
5,000	31	147	2.4	30	267	9.3	21	262	3.1	30	250	1.8	30	225	6.9	31	348	6.2	31	299	9.0	29	32	3.0	27	95	7.1	30	295	6.0	31	229	6.7	30	292	9.6	30	232	13.0
6,000	31	149	2.7	29	263	10.0	31	264	4.8	27	243	3.1	30	231	8.0	31	345	5.7	31	291	10.5	29	25	3.1	27	97	5.9	31	294	6.7	30	228	7.6	30	293	10.1	30	231	14.2
8,000	30	107	2.5	18	270	16.3	31	259	7.8	21	234	5.4	28	229	11.1	29	344	8.1	31	275	13.9	29	21	3.4	26	119	1.8	30	284	11.1	30	225	9.8	27	295	12.0	28	231	18.7
10,000	27	79	4.8				31	243	14.3	20	213	7.5	25	228	16.3	28	326	10.3	29	263	15.8	28	6	4.1	26	156	2.0	27	283	14.2	27	222	15.0	27	289	16.1	22	237	21.4
12,000	24	64	6.0				30	239	15.3	18	210	10.6	19	253	18.3	24	325	10.3	23	261	18.9	25	8	4.2	23	259	3.9	25	283	17.8	25	230	21.6	23	286	21.0	14	256	25.3
14,000	20	62	8.4				20	276	10.8	17	189	6.4	11	228	13.0	20	350	5.8	17	262	15.7	20	39	5.8	22	309	1.3	25	275	14.7	18	231	15.9	14	285	15.4			
16,000													10	233	10.4	12	37	2.2				12	32	9.0	18	107	8.7	24	281	10.1	11	227	13.4						
18,000																												15	299	2.9									

Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 m.)		
	Observations	Direction	Speed
Surface	31	188	2.7
500	31	234	2.9
1,000	31	223	3.3
1,500	31	206	4.1
2,000	31	200	4.7
2,000	30	209	4.8
3,000	30	222	5.6
4,000	29	223	7.6
5,000	28	225	8.6
6,000	28	229	10.6
8,000	26	231	12.4
10,000	24	237	14.6
12,000	18	239	16.6
14,000	12	238	12.7

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following Table III in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR AUGUST 1949

There were no major floods during August. The most important general flooding was that due to the heavy rains accompanying the tropical storm from the 26–28th in the Middle Atlantic States. Moderate floods resulted in North Carolina and southwestern Virginia.

Atlantic Slope drainage.—The drought that began in April in the Northeastern States continued unabated through August. According to reports from the Geological Survey ground-water levels were near record low in New England.

Scattered heavy showers (about 4 inches) early on the 15th caused flash flooding in the Harrisonburg, Va., area on a tributary of the North Fork of the Shenandoah. Major damage resulted from water backing into store buildings causing heavy stock damage. This same storm caused a moderate rise on the upper Rapidan River with slight damage due to light local overflows in the headwaters. Moderate rises occurred in the Rappahannock Basin in the headwaters in connection with the heavy rain induced by the passage of the tropical storm during the night of the 28–29th. Light rises occurred in the Potomac Basin. The tides in Washington, D. C., averaged about 1–3 feet above normal during the passage of the storm.

A rapid rise occurred in the James River to above bank-full stage at and below Bremo Bluff, Va., due to heavy thundershowers (4.1 inches) over the middle of the basin on the 14th and early 15th. At one time the river in the Bremo Bluff-Columbia reach was rising at a rate of slightly better than 2 feet per hour. Losses were small, consisting primarily of 300 feet of C. & O. R. R. track being washed out by the flooded Swan Creek at Warminster, Va., and of flood gates of the power company at Richmond becoming jammed and damaged. Flash floods occurred in the smaller streams in Nelson, Albemarle, Buckingham, and Surry Counties of Virginia.

Heavy rain (3 to 4 inches) occurred in eastern North Carolina, on the 28th due to the passage of the tropical storm causing sharp rises and heavy run-off in all rivers. Most of the rain occurred in from 1 to 2 hours. The Neuse River rose 11 feet in less than 24 hours at Neuse and Smithfield, N. C., and reached a stage of 7 feet above bank-full stage at the latter point on the 29th. The Cape Fear acted very much like the Neuse and registered a sharp rise at Fayetteville. Considerable crop damage occurred in the bottom lands along the Cape Fear and Neuse Rivers.

Heavy rains from the 16th to 19th caused slight flooding on the Edisto at Orangeburg, S. C. Heavy rains (3 to 4 inches) occurred again on the 28–29th over most of the drainage basins in South Carolina during the passage of the Florida hurricane causing light to moderate flooding in the main rivers and unusually high water in some small streams where the rainfall was heaviest. Most of the damage resulting was to crops.

The Ocmulgee River rose 10 feet at Macon, Ga., to a crest of 15 feet, 3 feet below flood stage due to the apparently heavy rains between reporting stations on the 16th.

East Gulf of Mexico drainage.—The Chattahoochee River rose 8 feet in 24 hours at Norcross, Ga., due to heavy rains in the headwaters on the 16th, rises downstream were light to very moderate.

Heavy thundershowers (1.85 inches) in the afternoon and night of the 1st resulted in light flooding on the Pearl River at Pearl River, La. The lower Pearl was already near bank-full stage before these showers so these additional amounts produced sufficient run-off to reverse the falling trend of the river and cause slight overflow for a short period. The losses were negligible as the lumbering industry had not resumed activity since the flood the previous month at this point.

Missouri Basin.—Flooding during the month was confined to a slight overflow on the upper Republican River in southwestern Nebraska, near Cambridge. The overflow was due to rains averaging about 1 inch over the basin above Cambridge during the 24-hour period ending on the morning of the 17th, followed by an additional amount of 1.75 inches on the 18th. No significant losses resulted from the overflow.

Ohio Basin.—The New River rose to three quarters bank-full stage at Galax, Va., and above on the 29th due to rain from the tropical storm on the 28th. Some of the smaller creeks were out of their banks but no damage was caused.

This same storm caused flood conditions along the Swannanoa River at Asheville, N. C., along the Watauga at Sugar Grove, and along the French Broad River from Asheville upstream to and beyond Rosman, N. C. The rain averaged between 2 and 4 inches throughout the area with heavier amounts up to 6 inches.

West Gulf of Mexico drainage.—Heavy rains averaging 3 to 6 inches, falling west to northwest of Del Rio, Tex., during the early morning hours of the 8th caused a rapid rise in the Devil's River and Pecos River, both tributaries of the Rio Grande. The waters from these two rivers merging in the Rio Grande resulted in moderate flooding at Del Rio and slight flooding at Eagle Pass, Tex. Flooding was confined to low places and no damages resulted.

FLOOD STAGE REPORT FOR AUGUST 1949

[All dates in August unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE					
James:	*Feet*			*Feet*	
Bremo Bluff, Va.	19	15	15	21.7	13
Columbia, Va.	18	15	15	21.9	15
State Farm, Va.	12	16	16	14.5	16
Richmond, Va.	8	16	16	8.3	16
Roanoke: Altavista, Va.	10	29	30	16.3	29
Tar: Rocky Mount, N. C.	9	30	31	9.3	30
Neuse:					
Neuse, N. C.	14	29	31	15.3	30
Smithfield, N. C.	13	29	(2)	19.0	31
Kinston, N. C.	14	24	27	16.3	25
Cape Fear:					
Fayetteville, N. C.	35	30	31	41.0	30
Lock No. 2, Elizabethtown, N. C.	20	19	19	21.4	19
		30	(2)	30.0	31
Yadkin: Wilkesboro, N. C.	14	29	(2)	17.1	29
Pee Dee:					
Cheraw, S. C.	30	30	31	31.5	30
Pee Dee, S. C.	19	24	(2)	21.9	Sept. 4
Saluda: Pelzer, S. C.	6	28	31	7.5	29
Broad:					
Gaffney (near), S. C.	10	28	30	12.4	29
Blairs, S. C.	14	22	23	16.0	22
		29	31	25.0	30
Congaree: Columbia, S. C.	19	29	31	22.4	30
Catawba: Catawba, N. C.	8	28	31	18.2	29
Wateree: Camden, S. C.	23	29	Sept. 1	28.0	30
Edisto:					
Orangeburg, S. C.	8	20	24	8.6	22
		29	Sept. 4	10.3	30
Givhans Ferry, S. C.	10	28	(2)	14.4	Sept. 4
EAST GULF OF MEXICO DRAINAGE					
Pearl: Pearl River, La.	12	3	5	12.4	4
MISSISSIPPI SYSTEM					
Missouri Basin					
Republican: Cambridge, Nebr.	5	17	19	5.7	17–18
				6.5	18–19
Ohio Basin					
Watauga: Sugar Grove, N. C.	9	28	28	11.1	28
Swannanoa: Biltmore, N. C.	10.5	28	28	12.6	28
French Broad: Asheville, N. C.	9	28	29	10.1	28
WEST GULF OF MEXICO DRAINAGE					
Rio Grande:					
Del Rio, Tex.	15	8	8	20.5	8
Eagle Pass, Tex.	16	9	9	16.0	9

[1] Provisional.

[2] Continued at end of month.

CLIMATOLOGICAL DATA FOR AUGUST 1949

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see Review, January 1943, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	79.6	−0.1	3 stations	99	17	Valley Head	57	25	4.61	−0.11	Brundidge	9.8	Sylvania	0.12
Arizona	77.5	−.6	do	116	12	2 stations	27	115	1.25	−1.00	Silver Creek Ranch	4.34	6 stations	T
Arkansas	77.7	−2.4	Camp Chaffee	104	13	Siloam Springs	42	22	3.11	−.42	Eagle Gap	8.99	Wedington Lake	.33
California	72.3	−2.5	Cow Creek	122	4	Boca	25	19	.10	−.07	Blacks Mtn. Branch	1.17	241 stations	.00
Colorado	66.0	+.3	Florence	104	21	Pearl	21	21	1.29	−.65	Bonny Dam	6.96	3 stations	.05
Florida	81.2	−.2	Fernandina	99	19	Milton Exp. Sta	62	24	11.05	+3.93	Brooksville Chinsegut Hill.	23.95	Pensacola, WB City	2.95
Georgia	79.1	−.7	2 stations	99	1	Cornelia	51	21	6.81	+1.48	Camp Stewart	13.89	Adairsville	1.53
Idaho	68.1	+1.5	do	109	12	2 stations	27	18	.35	−.23	Clark Fork, 1 ENE	1.71	Ola	.00
Illinois	74.6	.0	Pana	99	11	5 stations	45	121	2.90	−.46	Rock Island Dam 15	9.52	Des Plaines, 1 NW	.50
Indiana	73.8	+.1	Seymour, 1 N	100	110	2 stations	40	21	3.66	+.34	Elliston	11.51	W. Lafayette Purdue U.	.64
Iowa	73.0	+.4	4 stations	100	17	New Hampton	36	31	2.34	−1.42	Davenport	8.93	Toledo	.07
Kansas	75.9	−2.1	Bison	105	111	Alton, 6 E	38	31	2.72	−.39	Topeka	10.27	Toronto	.27
Kentucky	75.3	−.5	Owensboro	97	19	Princeton	48	30	4.54	+.84	Benton	10.11	Constantine	1.44
Louisiana	80.8	−1.1	Bogalusa	101	21	Logansport	50	23	4.04	−1.05	Grand Isle	13.92	Evans	.55
Maryland-Delaware	74.8	+1.3	Salisbury Police Brk's, Md.	102	11	Oakland, Md	40	21	4.32	−.19	Crisfield, Md	9.55	Bently Springs, Md	1.69
Michigan	68.8	+1.9	Bergland Hydro. Plant.	99	7	Watersmeet U. S. Forest	28	20	2.45	−.44	Yale	6.99	Cheboygan	.73
Minnesota	70.8	+3.0	2 stations	102	19	2 stations	36	120	2.01	−1.26	Hill City R. S.	5.54	Lake City	.10
Mississippi	79.9	−.9	Clarksdale	101	111	Holly Springs	55	1	3.89	−.25	Laurel	9.01	Russum	.92
Missouri	75.1	−1.5	6 stations	99	111	Vandalia	42	31	3.08	−.69	Seymour	7.47	St. Charles	.52
Montana	68.6	+3.0	2 stations	112	7	Summit	23	14	.57	−.56	Scobey	1.88	2 stations	.00
Nebraska	73.6	.0	Chadron	104	22	2 stations	40	130	2.74	+.05	Geneva	8.64	Merriman	T
Nevada	70.5	−.3	Overton	114	3	Fish Creek Ranch	26	12	.28	−.22	Schurz	1.15	11 stations	.00
New England	69.7	+2.5	Billerica, Mass	105	10	Somerset, Vt	32	21	2.86	−.85	Wolcott Reservoir, Conn.	7.21	South West Harbor, Maine.	.26
New Jersey	74.7	+2.7	Plainfield	106	11	Sussex	36	20	3.62	−1.09	Toms River	11.26	Moorestown	1.42
New Mexico	71.0	+.2	2 stations	104	115	2 stations	25	20	1.62	−.82	Bonita Dam	6.65	San Jon	.09
New York	70.5	+2.7	West Point	103	10	do	32	21	4.28	+.60	Watertown	8.55	Kendall	1.28
North Carolina	76.6	+.7	Weldon	100	12	Mt. Mitchell	42	21	9.31	+3.88	Davidson River Fish Sta.	17.36	Yanceyville	3.80
North Dakota	71.2	+4.5	2 stations	111	17	Parshall	30	30	.99	−1.07	Grand Forks University.	3.54	Elbowoods	T
Ohio	73.2	+1.5	Vickery, 2 NW	105	10	Millport, 2 NW	38	.20	3.31	−.06	Plymouth	7.63	Lowell Lock 3	.60
Oklahoma	78.6	−3.0	Altus Dam	106	20	Pawhuska	45	22	2.00	−.89	Bengal	6.01	Lyons	T
Oregon	65.1	−.5	Owyhee Dam	109	3	Chemult	22	25	.14	−.30	Otis	1.25	32 stations	.00
Pennsylvania	71.5	+1.2	Lock Haven 1	102	110	Philipsburg Ap., 7 E	31	120	3.67	−.46	Donegal	8.71	Schenley 15	.82
South Carolina	78.6	−.3	Cheraw	98	12	Paris Mtn	53	21	9.94	+4.17	Columbia WB Ap	16.72	Myrtle Beach	4.01
South Dakota	74.0	+2.9	2 stations	108	17	Deerfield Dam	24	31	1.93	−.18	Fairfax	6.75	Gelhaus Farm	.06
Tennessee	76.0	−.8	3 stations	98	111	Crossville Exp. Sta	51	30	4.28	+.31	Mount Le Conte	11.98	Dyersburg	.52
Texas	80.2	−2.6	Mirando City	110	119	2 stations	50	15	2.32	−.05	Camp Wood	8.12	4 stations	.00
Utah	70.3	+.1	Zion Nat'l. Park	109	5	Woodruff	27	19	.54	−.57	Park City	2.14	New Harmony	.00
Virginia	74.3	+.2	Danville	101	11	Monterey	42	21	7.01	+2.53	Holland, 1 E	15.57	Fredericksburg Embry Plant.	3.32
Washington	65.0	−.5	Richland, 2 NW	108	1	3 stations	29	114	.61	−.15	Clearwater	4.32	6 stations	.00
West Virginia	72.6	+.8	3 stations	98	111	Pickens No. 1	36	21	4.33	+.24	Crawford	9.51	New Cumberland Dam.	1.13
Wisconsin	70.2	+2.3	2 stations	99	17	Land O'Lakes	30	20	2.20	−1.12	Berlin Power Plant	5.42	Genoa Dam 8	.67
Wyoming	66.7	+2.4	Arvada, 3 N	109	7	Bondurant	19	21	.58	−.56	Pine Bluffs	2.39	Quaking Aspen Creek	.00
Alaska	59.9	−1.5	Eagle	91	16	Puntilla	25	116	2.55	−.10	Point Retreat	11.36	Fort Yukon	.12
Hawaii	73.5	−1.2	Kaanapali	90	12	Haleakala R. S	43	122	4.37	−2.90	Kukui	42.00	25 stations	.00
Puerto Rico	79.1	0	Guayama (3)	96	115	Guineo Reservoir (2)	56	120	7.06	−.17	Guineo Reservoir	14.00	Mona Island	1.56

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR AUGUST 1949

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Temperature of the air: Averages: Mean minimum	Temperature of the air: Averages: Mean	Temperature of the air: Averages: Departure from normal	Temperature of the air: Extremes: Highest	Temperature of the air: Extremes: Date	Temperature of the air: Extremes: Lowest	Temperature of the air: Extremes: Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [4]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Wind: Speed of fastest mile: Miles per hour	Wind: Speed of fastest mile: Direction	Wind: Speed of fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Character of day (sunrise to sunset), number of days: Partly cloudy	Character of day (sunrise to sunset), number of days: Cloudy	Sky cover, [7] tenths (sunrise to sunset)	Possible sunshine
NEW ENGLAND	*Ft.*	*Ft.*	*Ft.*	*Mbs.*	*Mbs.*	*Mbs.*	°F	F.	°F.	°F.	° F.		° F.			° F.	%	*In.*	*In.*	*In.*			*In.*	*In.*	*m. p. h.*						*0-3*	*4-7*	*8-10*	*0-10*	%
Caribou [2]	628	5	33	990.9	1,013.9		75	52	68.5	+3.2	88	27	38	25	101	54	73	2.93	−.8																5.8
Eastport	75	67	82	1,011.5	1,014.2	−1.0	72	56	63.4	+1.9	88	27	49	20	78		75	2.49	−.8	1.09	12	6	.0	0	11.3		45	wsw.	30	2	15	14	7.0	
Portland, Me. [2]	103	6	43	1,010.8	1,014.9	−1.0	81	57	69.0	+4.4	97	27	46	20	27	59	73	1.85	−1.2	.80	8	2	.0	0	7.9		30	s.	29	9	13	9	5.5	58
Concord [2]	289	5	45	1,005.1	1,015.5	−.4	83	56	69.5	+4.0	97	26	39	21	26	58	71	1.22	−1.9	.39	6	3	.0	0	5.4		40	s.	29	11	10	10	5.4	70
Mt. Washington	6,274	5	37	811.4	1,022.4		55	44	49.2	+1.2	63	8	28	20	485			2.04	−1.5	.78	7	5	.0	0	4.9		25	nw.	19	9	10	12	5.8	59
Burlington [2]	403	6	51	1,000.3	1,015.1	−.1	83	58	70.8	+2.9	97	8	44	25	20	59	69	6.27	+.1	2.75	12	3	.0	0	25.2						4	15	12	6.4	48
Boston [2]	124	33	62	1,011.2	1,015.9	.0	83	66	74.4	+4.5	101	10	54	20	1	60	66	4.42	+1.0	2.75	10	7	.0	0	7.4		36	nw.	10	12	11	8	5.2	60
Nantucket [2]	12	4	34	1,015.6	1,016.1	−.2	77	63	70.0	+2.2	92	10	51	17	6	65	84	2.12	−1.5	.59	9	3	.0	0	10.6		50	sw.	29	12	8	11	5.2	71
Block Island	26	11	46	1,015.2	1,016.3	.0	77	66	71.4	+2.9	89	11	58	20	1			1.95	−1.4	.66	9	6	.0	0	10.1		43	sw.	28	8	11	12	5.2	57
Providence [2]	159	65	60	1,010.2	1,016.0	−.3	85	64	74.4	+3.4	100	10	51	20	3	62	75	3.71	.0	1.63	9	5	.0	0	11.6		37	s.	29	9	10	12	6.0	58
Hartford [2]	159	5	44	1,010.2	1,016.0	−.3	85	64	74.4	+4.5	100	10	45	21	5	62	73	3.23	−.3	1.36	7	5	.0	0	7.0		36	se.	29	8	11	12	5.6	66
New Haven [2]	107	5	39	1,011.9	1,016.1	−.2	81	63	72.1	+3.5	93	11	48	21	2	64	74	3.02	−1.3	1.26	7	4	.0	0	6.4		36	se.	29	7	7	17	5.4	67
																		2.88	−1.1	1.50	10	6	.0	0	6.2		34	se.	29	9	9	13	6.6	64
MIDDLE ATLANTIC																																			
Albany [2]	97	6	40	1,011.5	1,015.3	−1.0	84	59	75.7	2.4	98	10	44	25	15	60	74	4.89	+.6															6.1	
Binghamton [4]	871	57	79	986.1	1,016.6	.0	84	59	71.6	+2.6	97	9	44	21	14	60	71	2.92	−.2	1.79	7	8	.0	0	6.3		29	w.	29	10	10	11	5.6	70
New York [4]	314	415	454	1,005.1	1,016.3	.0	84	69	71.6	+3.6	97	9	44	21	14	60	77	5.47	+1.9	2.86	7	4	.0	0	4.5		17	sw.	11	8	12	11	5.7	62
Allentown [2]	385	4	58	1,002.7	1,016.7		86	63	76.6	+3.5	99	10	56	20	0	63	68	3.87	−.5	1.20	11	8	.0	0	8.8		70	se.	29	6	13	12	6.2	61
Harrisburg [2]	374	30	49	1,002.7	1,016.4	−.2	85	64	74.4	+2.3	99	10	48	21	5	63	74	5.28	+.9	2.07	10	8	.0	0	5.0					7	11	13	6.1	
Philadelphia [4]	114	174	150	1,012.9	1,016.1	−.5	85	70	77.4	+2.6	98	10	50	20	3	63	72	2.49	−1.6	1.52	8	4	.0	0	4.4		34	w.	11	7	11	13	6.0	66
Reading	323	47	306	1,004.7	1,016.3	.0	85	67	76.0	+3.1	98	10	51	21	1	65	73	4.29	−.4	1.45	10	6	.0	0	7.0		29	se.	29	8	10	13	6.2	63
Scranton	805	72	104	987.8	1,016.6	−.3	84	62	72.8	+3.0	97	10	46	21	14			1.06	−3.2	.58	7	2	.0	0	7.4		35	se.	29	7	10	14	5.9	68
Atlantic City	52	37	172	1,013.9	1,015.6	−.7	81	71	76.1	+3.6	96	11	58	20	0			4.98	+1.3	1.68	12	7	.0	0	4.7		24	n.	15	12	12	7	5.1	51
Newark [2]	30	5	46	1,014.6	1,016.0		86	66	76.2	+3.2	102	10	52	20	1	63	68	3.37	−1.1	1.74	8	4	.0	0	12.3		56	se.	29	9	9	13	5.6	70
Trenton	190	89	107	1,009.1	1,015.9	−.4	84	66	75.4	+2.4	96	11	53	20	2			2.66	−2.0	1.06	10	4	.0	0	8.5		40	nw.	12	5	13	13	6.3	
Baltimore [4]	123	100	215	1,011.9	1,016.4	+.1	86	71	78.1	+2.6	98	10	58	20	0	66	71	1.79	−3.0	.88	9	6	.0	0	6.3		32	se.	29	8	11	12	5.9	66
Washington [4]	112	56	100	1,012.2	1,016.5	+.2	87	70	78.2	+3.2	96	11	57	21	0	65	70	2.82	−1.6	.93	10	5	.0	0	7.7		49	se.	29	7	13	11	5.8	61
Cape Henry	18	8	54	1,014.9	1,015.6	−.7	83	72	77.8	+.9	95	10	67	26	0			4.57	+.6	1.32	10	2	.0	0	8.3		43	e.	28	7	11	13	6.2	60
Lynchburg [2]	686	5	58	983.4	1,016.5	−.4	83	65	74.2	−.1	95	12	56	22	6	65	79	10.49	+5.6	5.17	17	10	.0	0	10.4		40	nw.	5	9	4	18	6.4	62
Norfolk [4]	91	80	125	1,012.9	1,016.4	−.5	86	72	78.8	+1.4	97	11	67	20	0	70	81	4.03	+.2	1.64	11	2	.0	0	6.1		34	e.	28	8	9	14	6.5	56
Richmond [4]	144	11	52	1,009.8	1,015.8	−.8	85	69	77.0	+.5	95	11	60	21	0	69	83	14.51	+9.3	4.59	17	9	.0	0	9.3		31	sw.	28	5	8	18	7.2	62
																		8.56	+4.1	2.18	18	10	.0	0	5.3		36	sw.	11	4	9	18	7.3	62
SOUTH ATLANTIC																																			
Asheville [4]	2,253	77	92	1,012.2	1,016.4	−.9	82	63	78.6	+.7	91	9	55	21	12	65	82	9.60	+4.0															7.0	
Charlotte [4]	779	63	86	988.8	1,016.1	−.8	86	69	72.4	+1.9	95	12	60	20	3	68	89	5.78	+1.6	1.85	15	9	.0	0	5.7	nnw.	25	se.	28	2	12	17	7.5	61
Greensboro [2]	886	6	56	985.4	1,016.7	−.6	84	67	77.5	+.4	95	12	60	20	3	68	79	6.53	+1.5	3.09	16	7	.0	0	5.8	nne.	24	ne.	28	3	9	19	7.3	50
Hatteras	11	5	47	1,015.6	1,016.0	−.6	84	74	75.5	−.1	94	11	59	20	2	67	80	11.71	−6.5	4.47	13	4	.0	0	7.5	ne.	38	se.	28	5	13	13	6.5	55
Raleigh [4]	376	5	71	1,000.4	1,016.4	−.2	86	70	79.0	+1.0	86	14	70	15	0	74	87	9.02	+3.3	3.79	14	10	.0	0	10.7	sw.	73	nw.	24	3	10	18	7.2	55
Wilmington	72	73	107	1,014.9	1,016.4	−.5	87	73	78.2	+1.2	95	11	63	21	0	70	82	8.70	+3.3	2.35	15	8	.0	0	6.2	sw.	32	se.	28	3	16	12	6.5	42
Charleston [4]	48	11	92	1,013.9	1,015.6	−1.3	88	73	80.1	+2.5	93	11	67	21	0	73		8.51	+2.2	2.61	20	12	.0	0	8.5	sw.	47	s.	28	5	13	13	6.4	60
Columbia, S. C. [4]	347	70	91	1,007.8	1,015.6	−1.3	88	70	79.0	−.6	94	25	64	22	0	71	80	15.40	+9.9	7.40	17	13	.0	0	9.4	ssw.	56	se.	28	3	15	13	6.9	66
Greenville, S. C. [4]	1,040	18	36	979.3	1,015.8	−.8	84	67	75.8	.0	92	12	56	21	10	63	81	8.62	+3.1	3.46	14	9	.0	0	6.8	ne.	52	ne.	28	4	9	18	7.1	59
Augusta [4]	182	62	77	1,000.4	1,015.5	−.8	89	72	80.4	.0	95	6	65	21	0	70	76	6.74	+1.7	3.40	15	14	.0	0	5.4	sw.	27	e.	28	3	13	15	6.9	66
Savannah [2]	65	19	51	1,013.5	1,015.7	−.9	90	73	81.3	+1.4	98	19	69	23	0	72	80	11.20	+3.9	4.01	16	16	.0	0	10.9	sw.	52	se.	28	1	17	13	7.0	48
Jacksonville [4]	43	86	110	1,014.6	1,015.9	−1.0	90	74	82.2	+.5	95	19	71	23	0	74	80	11.51	+5.7	3.48	18	19	.0	0	8.2	s.	48	se.	27	2	12	17	7.3	51
FLORIDA PENINSULA																																			
Key West [4]	21	10	64	1,015.2	1,016.0	+.4	89	78	82.2	−2	92	23	72	4	0	74	78	9.60	+3.4															6.2	
Miami [4]	25	242	249	1,014.9	1,015.9	−.7	86	77	83.7	+.2	90	21	71	7	0	73	75	4.85	+.3	1.35	17	18	.0	0	8.4	e.	36	sw.	27	7	16	8	5.5	65
Tampa [2]	35	5	36	1,014.2	1,015.7	−.9	89	74	81.4	−.7	94	17	71	6	0	73	81	5.36	−.5	1.95	16	16	.0	0	12.3	se.	60	sw.	27	6	14	11	6.0	76
									81.4	−.1								18.59	+10.4	5.37	17	19	.0	0	8.4	ssw.	54	sw.	27	3	11	17	7.2	56
EAST GULF																																			
Atlanta [2]	1,173	33	72	974.9	1,015.3	−1.6	86	70	80.6	+.3	93	9	60	22	0	68	78	4.79	−.4															6.2	
Macon [4]	370	79	87	1,002.4	1,015.2	−1.4	88	70	77.9	−.1	93	7	64	21	0	70	77	6.47	+1.8	2.23	13	5	.0	0	7.0	ene.	35	nw.	28	8	8	15	6.7	44
Apalachicola	35	11	51	1,013.5	1,014.9	−1.4	87	76	78.8	−1.1	91	26	72	13	0			7.34	+3.0	3.01	13	10	.0	0	5.7	sse.	30	n.	9	5	8	18	7.1	59
Pensacola [4]	56	54	79	1,013.2	1,015.0	−1.3	90	74	81.4	+.2	92	13	67	13	0			6.37	−1.2	2.31	17	17	.0	0	7.9	sw.	34	n.	27	7	11	13	6.2	66
Anniston	618	6	32	993.6	1,015.5	−1.1	89	73	82.3	+1.4	95	11	68	20	0	73		2.95	−5.1	1.14	14	16	.0	0	6.4	nnw.	26	n.	20	6	16	9	6.0	76
Birmingham [2]	700	5	63	993.2	1,015.5	−1.4	88	69	78.4		95	11	62	21	0	70	81	6.06	+2.0	2.20	13	14	.0	0	4.5	ene.				2	15	14	7.6	
Mobile [4]	57	86	161	1,007.5	1,015.2	−1.1	91	73	78.6	+.1	95	12	62	22	0	69	78	5.22	+1.0	1.06	17	14	.0	0	5.6	ne.	49	nw.	28	2	15	14	7.1	44
Montgomery [4]	218	92	105	1,007.8	1,015.0	−1.6	90	72	82.2	+1.2	95	14	69	25	0	71	79	4.45	−2.5	1.44	12	16	.0	0	8.1	n.	54	ne.	9	4	22	5	5.4	62
Meridian [4]	375	67	92	1,002.0	1,015.3	−.6	92	69	80.6	−.2	95	9	65	22	0	71	78	4.95	+.7	1.75	10	9	.0	0	5.4	sw.	26	w.	20	7	12	12	6.2	57
Vicksburg [4]	247	82	102	1,006.4	1,015.1	−1.2	90	72	80.5	+1.0	97	15	64	23	0	71	79	2.50	−2.0	1.31	12	12	.0	0	4.4	sw.				3	19	9	6.3	
New Orleans C. O.	53	76	84	1,013.2			91	76	80.6	−.2	95	13	62	22	0	71		1.98	−1.5	1.01	7	8	.0	0	6.0	nw.	31	sw.	5	11	14	6	5.2	79
New Orleans A.P. [2]	30	6	52	1,013.2	1,015.1	−.8	91	74	83.1	+.9	96	20	69	26	0			5.51	−.3	2.14	10	16	.0	0	5.3		22	sw.	20	7	20	4	5.2	56
									82.2		95	20	68	24	0	72	77	3.63		1.19	9	16	.0	0	7.0	sw.	32	nnw.	14	9	16	6	5.2	
WEST GULF																																			
Shreveport [2]	181	5	64	1,006.1	1,015.1	−.1	92	70	82.4	−.5	98	12	57	22	0	71	79	2.44	−.6															4.6	
Fort Smith [2]	463	6	30	998.6	1,014.5	−.1	92	68	81.1	−1.7	98	12	55	22	0	71	76	1.06	−1.6	.52	8	7	.0	0	7.1	se.	30	se.	3	15	10	6	4.3	73
Little Rock [2]	265	26	58	1,003.1	1,014.3	−1.3	88	70	79.6	−.9	101	12	55	22	0	67	76	1.42	−1.9	.36	7	4	.0	0	6.3	ne.	25	s.	4	10	10	11	5.3	78
Austin [2]	621	5	41	993.2	1,014.6	+.4	94	70	79.0	−.8	97	12	62	22	0	69	76	6.01	+2.3	2.96	13	10	.0	0	4.9	sw.	29	se.	8	8	11	12	5.8	65
Brownsville [2]	20	5	54	1,012.2	1,013.3	+.1	92	75	83.6	−.3	96	15	70	24	0	73	76	4.14	+1.3	1.85	8	5	.0	0	9.6	se.	30	se.	5	11	15	5	4.7	71
Corpus Christi [2]	44	6	33	1,013.5	1,014.6	.0	93	73	83.0	+1.4	99	21	66	23	0	73	75	1.40	−.9	.67	5	7	.0	0	8.1	sse.	39	se.	5	11	13	7	4.6	87
Dallas [2]	488	34	45	997.0	1,014.6	.0	94	72	82.6	−.9	105	19	63	23	0	66	61	.79	−2.0	.27	7	5	.0	0	7.3	se.	38	sw.	15	16	7	8	3.8	86
Fort Worth [2]	706	40	56	990.9	1,014.6	+.7	94	72	83.0	+.3	104	15	64	23	0	65	58	2.27	−.4	2.11	4	5	T	0	12.0	se.	44	nnw.	31	17	8	6	3.8	
Galveston [4]	54	122	129	1,014.6	1,015.2	.0	87	78	82.4	−.6	92	20	69	3	0	73	75	3.32	−1.0	1.37	9	9	.0	0	12.0	se.	47	ne.	3	12	12	7	4.6	80
Houston [4]	138	157	190	1,012.2	1,014.8	−.4	92	74	82.6	−.6	98	20	66	3	0	73	78	3.83	−.3	1.05	9	11	.0	0	8.8	se.	33	ne.	31	11	11	9	5.3	61
Laredo [2]	418	10	38	997.6	1,012.6		100	76	88.0	+1.1	106	15	71	3	0	68	56	.24	−1.4	.15	6	2	.0	0	12.8	se.				2	13	6	4.7	
Palestine	510	64	72	997.0			90	71	80.2	−1.6	98	19	62	24	0			3.02	+.8	2.09	7	6	.0	0	5.6	e.	20	nw.	16	16	8	7	4.3	53
Port Arthur [4]	34	59	134	1,013.9	1,014.8	−.4	90	75	82.8	−.4	96	20	67	26	0	72	80	3.33	−2.7	1.13	9	13	.0	0	5.0	w.	30	s.	4	11	13	7	5.1	70
San Antonio [2]	794	6	51	990.2	1,014.4	+.5	94	71	82.5	−1.0	101	2	65	24	0	67	65	1.03	−1.4	.68	6	3	.0	0	7.1	se.	35	se.	20	17	8	6	4.2	78

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR AUGUST 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [4]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Maximum velocity: Average hourly speed	Prevailing direction	Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover [7] tenths (sunrise to sunset)	Possible sunshine
OHIO VALLEY AND TENNESSEE	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m. p. h.					0–3	4–7	8–10	0–10	%
									75.3	+1.0							76	3.43	−.1															5.8	
Chattanooga [2]	762	6	66	990.9	1,015.5	−1.1	87	68	77.7	+2.0	94	10	62	30	0	69	79	3.46	−.6	.91	13	7	.0	0	2.7	ne.	36	sw.	2	4	14	13	6.6	49
Knoxville [2]	995	27	71	981.7	1,016.0	−.9	86	68	77.0	+1.6	96	14	60	30	0	68	78	5.07	+1.2	1.00	13	7	.0	0	4.6	ne.	27	ne.	20	6	13	12	6.4	65
Memphis [5]	399	5	49	1,005.1	1,015.0	−.9	90	68	79.5	+1.1	98	12	60	21	0	69	75	2.36	−1.0	1.29	9	17	.0	0	5.4	n.	24	nw.	28	9	10	12	5.4	78
Nashville [2]	546	5	72	995.9	1,015.5	−1.1	87	67	77.2	−.6	95	27	60	21	0	68	80	2.87	−.8	1.02	11	10	.0	0	4.2	n.	21	w.	9	6	10	15	6.5	45
Lexington [2]	989	4	58	981.4	1,016.6	+.3	85	65	74.9	+.4	92	11	55	21	0	65	77	4.37	+.9	.72	15	12	T	0	5.5	ne.	---	---	---	6	18	7	5.4	--
Louisville [2]	525	5	54	998.0	1,015.7	−.9	87	66	76.4	+.3	94	11	55	21	0	66	75	3.47	+.1	.76	14	12	.0	0	4.5	ne.	35	w.	31	6	14	11	5.6	67
Evansville [2]	431	6	40	1,000.7	1,016.1	−.2	86	66	76.0	+1.0	94	9	54	21	0	67	78	3.80	+.4	1.75	8	10	T	0	5.1	nnw.	30	se.	9	9	12	10	5.5	67
Indianapolis [2]	823	5	54	987.5	1,016.3	−.3	84	64	73.8	+1.4	93	9	52	21	1	63	73	6.64	+3.3	2.72	9	7	.0	0	7.0	ne.	34	s.	11	12	9	10	5.1	63
Terre Haute [2]	575	4	36	995.6	1,016.3	+.4	85	63	74.2	−.6	92	9	51	21	0	65	76	2.96	−.3	1.17	11	10	.0	0	6.3	nne.	30	nw.	11	12	9	10	5.1	68
Cincinnati [4]	627	135	148	993.9	1,016.6	.0	87	68	77.2	+1.7	96	11	57	21	0	64	75	2.76	−.6	.98	13	7	.0	0	6.0	ssw.	22	nw.	31	13	9	9	5.0	66
Columbus [4]	822	90	110	987.1	1,016.6	.0	85	66	75.4	+2.4	94	11	52	21	1	64	74	2.37	−.9	1.26	9	8	.0	0	5.0	n.	31	sw.	27	8	14	9	5.5	68
Dayton [2]	1,003	6	55	981.0	1,016.6	+.3	84	63	73.5	+.6	92	10	52	20	2	62	72	2.61	−.7	1.13	8	8	.0	0	7.2	nne.	32	nw.	31	9	15	7	5.3	72
Elkins [2]	1,947	5	45	947.5	1,017.4	−.2	80	58	68.8	+.5	88	11	48	21	18	62	84	3.16	−.7	.89	14	8	.0	0	4.2	------	22	se.	16	1	14	16	7.5	54
Parkersburg	637	77	84	------	------	------	84	64	74.5	+.6	94	11	53	21	1	---	--	3.36	−.2	1.34	13	10	.0	0	4.9	------	32	nw.	4	10	8	13	5.9	58
Pittsburgh [2]	842	39	54	972.2	1,016.8	+.2	83	63	73.4	+2.1	94	9	50	21	5	61	71	2.22	−1.0	.71	7	5	.0	0	7.4	------	24	w.	11	6	15	10	5.7	63
LOWER LAKES									72.4	+3.2							69	4.21	+1.2														4.4	
Buffalo [2]	768	34	96	988.8	1,016.6	+.7	82	61	71.6	+3.2	90	9	49	21	8	59	67	5.27	+2.2	2.63	8	5	.0	0	10.5	------	52	nw.	3	15	9	7	4.4	79
Canton	448	10	61	999.0	1,014.9	.0	82	58	70.2	+3.7	95	9	43	25	31	56	63	3.95	+.3	1.21	11	4	.0	0	6.7	------	29	w.	3	13	10	8	4.8	68
Oswego	335	71	85	1,003.4	1,015.6	−.3	80	64	71.8	+4.0	89	10	51	25	10	---	--	2.85	+.2	1.60	10	3	.0	0	7.4	------	26	n.	13	19	6	6	3.6	78
Rochester [2]	523	4	69	997.3	1,016.4	+.1	84	60	72.0	+2.8	98	9	47	20	11	58	67	2.93	+.1	1.45	8	5	.0	0	7.6	------	34	w.	31	13	13	5	4.5	79
Syracuse [2]	596	5	57	994.6	1,016.1	−.5	85	60	72.8	+5.5	97	10	43	25	14	58	67	3.92	+1.1	2.48	6	3	T	0	6.4	------	36	sw.	28	13	12	6	4.8	79
Erie [4]	714	57	81	------	------	------	80	65	72.6	+3.0	89	9	54	21	5	---	--	7.54	+4.3	4.25	9	8	.0	0	5.7	------	26	sw.	11	16	12	3	3.5	65
Cleveland [2]	762	27	54	989.2	1,016.7	+.1	85	62	73.4	+3.2	96	9	47	21	4	61	71	3.59	+.8	2.54	8	5	.0	0	8.9	s.	38	w.	30	16	10	5	4.0	74
Sandusky	629	5	67	994.2	------	------	84	66	74.8	+3.0	96	10	53	21	0	---	--	2.92	−.2	1.05	9	4	.0	0	6.3	------	24	n.	27	12	11	8	4.5	83
Toledo [2]	628	5	47	993.6	1,016.5	−.1	84	63	73.1	+2.9	96	9	50	20	9	61	71	6.13	+3.3	2.63	10	7	T	0	6.9	sw.	43	nw.	31	13	11	7	4.9	80
Fort Wayne [2]	857	5	34	986.8	1,016.7	+.1	83	62	72.5	+1.6	92	10	48	20	11	62	73	2.83	−.3	1.78	8	7	0	0	5.0	ne.	28	nw.	31	10	12	9	5.2	69
Detroit [2]	730	5	77	990.9	1,016.9	+.3	82	62	71.9	+2.7	94	10	48	20	13	61	71	4.40	+1.6	1.41	10	3	.0	0	7.2	n.	34	nw.	31	13	13	5	4.4	72
UPPER LAKES									69.6	+3.5							72	1.86	−1.0														4.6	
Alpena	609	5	89	994.6	------	------	77	60	68.5	+4.4	95	8	48	21	32	---	--	2.07	−.8	.85	9	7	T	0	7.9	------	30	n.	27	10	12	9	5.1	72
Escanaba	612	51	72	994.2	------	------	76	60	67.6	+3.3	93	8	42	31	40	---	--	2.62	−.6	1.04	11	4	.0	0	9.0	------	30	n.	18	14	11	6	4.3	69
Grand Rapids [4]	707	70	244	991.5	1,016.5	+.2	84	62	73.0	+3.3	93	8	49	20	6	60	70	.76	−1.8	.45	7	2	.0	0	7.4	wsw.	26	sw.	6	16	9	6	4.2	76
Lansing [4]	878	5	90	985.4	1,016.9	+.6	82	59	70.2	+.9	93	9	45	20	23	60	73	1.61	−1.2	.58	10	8	.0	0	10.0	sw.	33	nw.	6	14	12	5	4.1	74
Marquette	734	44	73	989.2	------	------	76	59	67.7	+3.9	97	8	43	31	58	---	--	2.07	−.6	.95	10	5	T	0	6.7	------	33	w.	27	8	11	12	5.8	59
Sault Sainte Marie [3]	614	10	52	990.2	1,016.7	+.8	76	55	65.2	+4.4	90	8	42	20	71	57	77	2.47	−.2	1.58	9	4	T	0	6.2	sw.	26	w.	27	10	12	9	5.6	67
Chicago [2]	673	5	38	993.9	1,016.4	+.1	85	64	74.7	+3.1	95	8	50	31	2	62	67	1.31	−1.7	.58	8	5	T	0	7.0	ssw.	54	nw.	31	14	7	10	4.8	69
Green Bay	617	5	32	993.9	------	------	82	59	70.2	+2.5	94	8	42	31	15	---	--	2.45	−.7	1.48	10	6	.0	0	7.4	------	33	sw.	26	13	14	4	4.3	80
Milwaukee [2]	681	33	66	991.5	1,016.5	+.2	81	63	72.0	+4.4	94	8	49	31	5	61	72	1.08	−1.6	.55	6	3	.0	0	10.1	nne.	50	w.	31	15	11	5	4.2	73
Duluth [4]	1,133	5	47	965.5	1,016.2	+1.0	77	58	67.2	+4.6	94	7	43	31	44	---	--	2.13	−1.0	1.78	6	9	.0	0	13.0	ese.	26	e.	23	13	15	3	3.9	71
NORTH DAKOTA									72.2	+6.3							62	1.25	−.9														4.5	
Fargo [2]	940	5	47	980.0	1,013.9	−.3	86	60	72.6	+6.5	101	7	44	30	30	---	--	1.19	−1.7	.61	4	5	.0	0	12.3	s.	34	nw.	24	12	15	4	4.4	78
Bismarck [2]	1,677	5	41	954.6	1,013.9	−.3	88	57	72.4	+5.7	105	7	40	31	20	56	62	3.25	+1.4	1.95	8	10	T	0	9.5	ese.	57	nw.	12	16	8	7	4.5	81
Devils Lake	1,478	11	44	961.7	------	------	86	57	71.6	+6.8	103	7	40	30	39	---	--	.37	−2.1	.16	5	7	.0	0	7.5	------	28	ne.	18	17	8	6	3.8	83
Williston	1,878	42	50	947.2	------	------	87	58	72.4	+6.3	108	7	41	30	22	---	--	.20	−1.3	.17	3	7	.0	0	6.5	------	30	nw.	8	8	15	8	5.4	94
UPPER MISSISSIPPI									74.5	+2.0							74	3.05	−.3														4.4	
Minneapolis-St. Paul [2]	919	43	74	982.4	1,015.3	+.7	85	63	74.2	+4.3	97	7	47	31	14	60	65	2.64	−.5	1.37	7	6	T	0	8.5	s.	26	nw.	31	14	13	4	3.9	79
La Crosse [2]	672	5	29	991.5	1,016.0	+.8	85	60	72.6	+3.2	97	7	43	31	21	60	69	2.01	−1.7	.76	6	6	.0	0	6.7	s.	26	nw.	31	16	10	5	4.1	84
Madison [2]	974	27	39	985.8	1,016.8	+1.2	85	59	72.0	+2.5	96	7	45	29	13	60	69	2.20	−1.0	1.57	5	5	T	0	8.9	ne.	35	nw.	31	17	7	7	4.2	80
Charles City	1,015	10	51	981.4	1,017.6	+1.7	85	61	73.0	+3.9	95	7	47	31	8	---	--	.88	−2.6	.79	3	4	.0	0	5.3	------	15	sw.	5	16	10	5	3.7	74
Moline [2]	606	6	50	994.6	1,016.9	+1.0	84	63	73.5	+1.8	93	8	50	21	3	63	72	7.12	+3.6	4.44	9	8	.0	0	6.0	sw.	49	sw.	27	17	6	8	4.3	77
Des Moines [4]	860	5	99	985.8	1,016.4	+1.5	85	64	74.5	+1.4	95	11	51	31	3	63	82	6.52	+3.0	3.53	7	7	.0	0	7.4	------	42	s.	11	14	8	9	4.7	76
Dubuque	699	60	79	991.2	1,016.3	+.4	84	64	74.2	+2.5	95	7	51	31	1	62	72	3.09	−.2	1.58	7	7	.0	0	4.6	------	17	se.	10	14	8	9	4.2	82
Burlington [2]	702	4	36	991.5	1,016.5	+1.3	86	63	74.5	+.5	96	7	50	31	2	63	86	1.58	−2.0	.64	6	5	.0	0	8.8	------	47	sw.	10	17	6	8	4.4	81
Cairo	357	5	99	1,002.7	------	------	88	70	79.1	+.3	95	12	60	21	0	---	--	3.21	+.2	1.00	9	13	.0	0	5.4	------	29	sw.	11	5	13	13	6.2	83
Peoria [2]	609	7	26	994.6	1,016.5	−.1	86	64	74.5	+1.4	93	8	50	31	0	63	70	1.28	−1.8	.58	9	7	.0	0	7.9	ssw.	40	w.	31	15	6	10	4.5	78
Springfield, Ill. [4]	636	5	49	994.2	1,016.3	+.4	85	63	74.0	+1.8	92	9	50	31	2	65	75	4.21	+1.0	2.03	9	9	.0	0	6.6	ne.	42	w.	31	14	10	7	4.4	83
St. Louis [4]	568	33	59	995.6	1,015.6	.0	87	70	78.1	+.6	93	14	57	21	0	65	80	1.86	−1.1	1.59	4	7	.0	0	----	------	29	n.	31	11	15	5	4.5	65
MISSOURI VALLEY									75.2	+1.2							79	3.28	.0														4.5	
Columbia, Mo. [4]	784	6	66	987.8	1,015.7	+1.8	87	65	76.0	−.3	94	11	54	22	0	65	89	2.39	−1.2	1.03	8	8	.0	0	4.7	------	20	w.	10	14	12	5	4.4	74
Kansas City [2]	963	38	76	988.8	1,015.5	+.9	88	67	77.2	+.6	96	11	54	21	0	64	75	3.15	−.4	.99	7	8	.0	0	6.5	------	34	ne.	12	13	11	7	4.7	87
St. Joseph [2]	967	5	51	981.4	1,015.5	+1.3	88	64	75.8	−.7	97	11	52	31	0	64	83	1.58	−2.3	.95	5	6	.0	0	7.4	------	27	nw.	31	14	9	8	4.5	76
Springfield, Mo. [2]	1,324	5	50	971.2	1,016.0	+.4	85	63	74.2	−.8	92	1	50	21	2	64	89	2.48	−1.6	.82	10	14	.0	0	6.5	------	43	sw.	13	8	14	9	5.5	76
Topeka [4]	987	65	87	984.4	1,015.8	+2.6	89	65	77.1	+.9	99	12	58	21	0	64	85	10.27	+6.2	4.85	8	6	T	0	6.9	------	40	n.	13	13	12	6	4.8	78
Lincoln [4]	1,189	6	81	973.2	1,015.4	+1.5	86	65	75.2	+.8	96	12	53	31	1	63	83	2.16	−1.4	.80	9	5	.0	0	7.2	------	39	nw.	16	10	11	10	5.2	78
Norfolk, Nebr. [3]	1,551	5	38	960.7	1,015.6	------	86	62	73.8	+.7	100	12	48	31	8	60	77	3.08	.0	1.34	8	10	T	0	----	------	---	---	---	17	7	7	3.9	--
Omaha [2]	1,105	5	68	980.7	1,015.6	+1.0	85	64	75.0	+1.8	94	11	52	31	3	64	81	3.43	+.4	2.84	8	8	.0	0	7.9	------	34	e.	11	15	5	11	4.5	74
Valentine	2,598	46	54	924.8	1,014.9	+.3	87	61	74.0	+2.3	102	11	43	31	12	55	53	1.30	−.9	1.07	7	9	.0	0	8.9	------	29	s.	23	17	8	6	4.0	84
Sioux City [2]	1,138	5	40	974.9	1,015.3	+1.1	86	62	73.6	+2.4	95	7	47	31	6	62	83	3.62	+.5	1.77	6	6	.0	0	7.1	------	36	n.	11	14	9	8	4.5	74
Huron [2]	1,301	5	41	968.2	1,014.1	−.1	88	61	74.8	+5.4	99	6	44	31	13	59	72	2.59	+.1	.95	8	9	.0	0	11.2	------	70	s.	12	16	11	4	4.0	27

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR AUGUST 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Temperature of the air: Averages: Mean minimum	Temperature of the air: Averages: Mean	Temperature of the air: Averages: Departure from normal	Temperature of the air: Extremes: Highest	Temperature of the air: Extremes: Date	Temperature of the air: Extremes: Lowest	Temperature of the air: Extremes: Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [6]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Precipitation: Days with thunderstorms	Precipitation: Total snowfall (unmelted)	Precipitation: Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Wind: Speed of fastest mile: Miles per hour	Wind: Speed of fastest mile: Direction	Wind: Speed of fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Character of day (sunrise to sunset), number of days: Partly cloudy	Character of day (sunrise to sunset), number of days: Cloudy	Sky cover, 7 tenths (sunrise to sunset)	Possible sunshine
NORTHERN SLOPE	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	° F.		° F.			° F.	%	In.	In.	In.			In.	In.	m. p. h.					0–3	4–7	8–10	0–10	%
									70.4	+3.7							50	.57	−.5														4.1	
Billings [3]	3,570	16	39	892.0	1,012.9	−1.3	88	59	73.4	+2.8	103	6	50	31	2	43	37	.22	-----	.16	2	6	.0	0	8.5	sw.	50	nw.	23	16	9	6	4.1	71
Butte	5,533	44	58	832.4	1,016.7	-----	81	43	62.0	+1.3	94	6	35	14	130	38	45	.71	−.2	.41	10	16	T	0	8.3	s.	----	----	---	8	17	6	4.9	--
Glasgow	2,086	34	53	940.1	1,013.2	-----	91	57	73.8	+5.2	108	7	36	31	18	46	41	.69	−.5	.42	6	8	T	0	----	----	----	----	---	15	10	6	4.2	--
Great Falls [3]	3,657	16	75	889.3	1,013.7	-----	85	57	71.0	+3.9	101	6	45	26	12	41	36	.27	−.9	.13	3	4	T	0	10.2	sw.	52	w.	23	15	12	4	3.6	89
Havre	2,507	11	67	926.2	1,013.5	−.4	89	56	72.5	+7.1	106	6	43	30	17	----	--	.23	−1.0	.09	5	8	.0	0	7.1	w.	50	sw.	23	16	10	5	4.2	82
Helena [3]	4,124	5	43	874.7	1,014.1	−.1	86	51	68.3	+3.7	102	6	41	14	27	42	43	.66	−.1	.33	8	13	T	0	7.4	w.	59	s.	11	15	10	6	4.2	76
Missoula [3]	3,263	4	32	901.8	1,014.1	−.1	86	49	67.6	+3.4	98	5	38	14	41	40	41	.22	−.5	.12	5	8	.0	0	6.6	nw.	43	s.	10	12	15	4	3.8	79
Kalispell	2,973	48	56	912.0	1,013.5	−.4	80	50	65.1	+2.3	94	6	37	14	70	44	--	.56	−.3	.28	5	5	.0	0	9.2	nnw.	----	----	---	16	9	6	3.9	--
Miles City [3]	2,371	5	28	930.9	1,013.2	−.7	92	60	75.8	-----	110	7	45	31	8	44	--	.11	-----	.05	3	2	.0	0	8.2	wnw.	----	----	---	17	9	5	3.8	--
Rapid City [3]	3,259	5	56	902.1	1,013.1	−1.5	90	59	74.2	+4.7	104	22	44	30	9	47	62	1.16	−.5	.46	6	10	T	0	12.5	-----	47	nw.	8	815	14	2	3.8	78
Cheyenne [3]	6,094	22	40	815.4	1,014.2	−.4	81	53	67.0	+1.4	92	22	43	30	27	46	75	2.04	+.5	.97	12	17	1.0	0	8.5	-----	28	n.	18	8	19	4	4.9	78
Lander [3]	5,352	6	30	831.7	1,013.9	.0	86	55	70.1	+4.6	97	6	48	30	3	38	32	.09	−.4	.03	6	3	.0	0	7.3	-----	37	se.	5	11	13	7	4.7	72
Sheridan [3]	3,790	5	38	885.2	1,013.4	−2.5	90	55	72.7	+6.2	105	6	43	30	7	43	59	.10	−.8	.07	3	10	.0	0	6.7	-----	45	nw.	4	18	8	5	3.6	67
North Platte [3]	2,821	11	51	918.1	1,014.6	+.4	86	60	72.8	+2.0	96	12	47	31	5	58	79	.95	−1.4	.30	8	9	.0	0	8.9	-----	38	nw.	16	14	13	4	3.9	74
MIDDLE SLOPE																																			
									75.9	−.6							70	1.68	−.9														4.3	
Denver [4]	5,292	106	113	839.5	1,013.5	−1.1	85	61	72.9	+2.2	94	22	54	29	3	48	69	.55	−.9	.34	9	9	.0	0	6.5	-----	34	nw.	8	11	17	3	3.9	79
Pueblo [3]	4,690	5	36	859.1	1,013.6	+.1	88	58	73.1	+.4	98	23	52	26	3	51	74	.42	−1.4	.21	6	10	T	0	5.9	-----	50	w.	17	13	12	6	4.5	73
Concordia	1,392	50	58	966.8	1,015.2	+1.3	87	66	76.2	−.3	97	11	54	31	0	----	--	1.85	−1.1	.75	7	7	.0	0	7.2	-----	25	n.	17	13	10	8	4.5	69
Dodge City [3]	2,509	5	58	928.9	1,014.6	+.7	88	64	75.6	−2.1	98	12	56	31	0	60	72	2.57	−.1	1.09	8	10	.0	0	11.2	-----	50	nw.	29	13	14	4	4.3	83
Wichita [3]	1,358	52	64	967.8	1,015.0	+1.5	90	66	76.6	−1.7	98	12	57	31	0	62	74	1.13	−2.0	.27	9	11	.0	0	11.3	-----	36	n.	18	14	10	7	4.2	78
Oklahoma City [4]	1,214	10	47	969.2	1,015.0	+1.1	90	68	79.0	−.7	96	12	59	22	0	64	66	1.70	−1.2	.91	7	6	.0	0	9.9	s.	17	sw.	11	15	10	6	4.1	71
Tulsa [3]	674	10	60	991.2	1,015.1	-----	90	66	78.0	−2.1	99	13	53	22	0	65	68	3.54	+.3	2.20	8	10	.0	0	7.1	s.	31	n.	13	13	12	6	4.7	78
SOUTHERN SLOPE																																			
									79.2	−1.2							60	2.47	−.2														4.2	
Abilene [3]	1,755	4	59	953.9	1,013.6	+.4	92	68	80.4	+.1	100	19	61	3	0	62	57	2.20	−.0	1.69	5	5	.0	0	10.4	s.	45	n.	31	11	8	12	5.4	76
Amarillo [3]	3,604	5	42	891.0	1,013.9	.0	88	62	74.8	+.2	96	13	50	26	1	60	64	3.78	+.7	1.92	13	12	T	0	9.8	s.	42	n.	26	14	14	3	3.8	80
Del Rio	960	63	71	979.7	1,012.7	+.5	93	72	82.4	−1.8	102	2	65	2	0	67	65	3.29	+1.6	2.90	5	5	.0	0	6.8	e.	40	e.	2	17	7	7	3.8	74
Roswell [3]	3,614	6	29	892.7	1,013.3	+.4	91	63	76.6	.0	98	19	56	6	0	57	55	1.33	−.8	.65	7	13	.0	0	7.1	s.	33	s.	20	16	13	2	3.9	73
Wichita Falls [3]	1,030	4	49	978.3	1,014.1	-----	93	70	81.6	−4.3	102	19	60	22	0	63	57	1.77	−.4	.93	7	7	.0	0	11.1	se.	55	nnw.	19	14	9	8	4.3	--
SOUTHERN PLATEAU																																			
									81.1	+1.0							39	.79	−.8														3.0	
El Paso [3]	3,916	35	85	886.9	1,011.5	+.3	92	68	80.1	+2.1	99	30	59	6	0	54	44	.43	−1.3	.28	4	14	.0	0	9.1	se.	40	ne.	31	14	11	6	4.4	77
Albuquerque [3]	5,314	5	45	850.3	1,010.5	−.3	90	62	76.3	+2.4	94	31	56	19	0	49	43	.72	−.5	.45	6	8	.0	0	7.5	n.	42	se.	31	18	10	3	3.8	82
Flagstaff	6,907	34	48	795.5	1,017.1	-----	82	47	64.6	+.6	89	30	37	18	68	38	44	1.26	−1.5	.72	4	9	.0	0	5.1	nnw.	----	----	---	20	6	5	3.1	--
Phoenix [4]	1,107	39	87	971.6	1,009.4	+.6	104	74	88.6	+.1	111	2	65	11	0	55	36	.41	−.5	.40	2	3	.0	0	5.1	se.	41	e.	6	24	6	1	1.7	93
Tucson [3]	2,555	5	39	924.1	1,010.6	+2.1	98	70	84.2	.0	105	30	65	16	0	49	35	1.92	−.4	1.40	4	9	.0	0	7.7	sse.	42	e.	2	20	4	7	3.1	88
Yuma [3]	142	9	54	1,003.7	1,008.6	+.5	107	78	92.8	-----	115	2	69	12	0	56	33	T	-----	T	0	0	.0	0	5.8	se.	30	e.	6	24	4	3	1.9	93
MIDDLE PLATEAU																																			
									70.4	+1.5							41	.28	−.4														3.1	
Ely [3]	6,262	8	41	811.7	-----	-----	84	45	64.5	+3.2	92	4	37	25	73	----	--	.18	−.9	.12	3	4	.0	0	11.4	-----	34	n.	1	21	7	3	2.7	83
Reno [3]	4,527	20	52	863.2	1,014.1	+1.6	86	44	65.2	−.5	98	3	37	21	47	39	44	.11	−.1	.09	4	4	T	0	5.5	s.	28	nw.	15	21	5	5	2.7	86
Winnemucca	4,339	5	56	867.6	-----	-----	90	52	71.0	+1.7	101	3	43	26	0	----	--	.11	−.1	.09	2	4	.0	0	6.8	-----	28	s.	22	18	9	4	3.5	76
Salt Lake City [3]	4,357	32	58	871.0	1,011.5	−.7	91	61	76.0	+3.2	102	5	54	18	0	42	34	.70	−.2	.50	4	5	T	0	10.3	sse.	50	w.	4	19	8	4	3.0	87
Grand Junction [3]	4,602	5	26	860.8	1,013.0	−.5	90	60	75.5	+.1	99	1	54	20	0	40	45	.32	−.9	.16	4	11	.0	0	7.5	-----	34	ne.	7	15	12	4	3.8	79
NORTHERN PLATEAU																																			
									68.5	+1.4							41	.20	−.2														3.5	
Baker [4]	3,471	36	54	896.0	1,014.5	−.7	85	49	67.2	+2.6	98	3	39	13	40	40	--	.26	−.2	.13	3	4	.0	0	5.7	n.	22	w.	10	17	11	3	3.2	83
Mesacham	4,056	7	28	878.4	1,016.7	-----	77	48	62.4	-----	91	1	38	13	131	40	47	.16	-----	.09	3	6	.0	0	5.7	nnw.	----	----	---	17	10	4	3.3	--
Boise [3]	2,739	5	49	918.1	1,011.8	−1.1	89	58	73.6	+2.6	105	3	48	8	1	42	34	.12	−.1	.08	3	6	.0	0	10.6	nw.	50	se.	22	16	11	4	3.5	87
Lewiston	1,436	4	23	962.8	1,013.5	-----	89	57	73.1	-----	103	3	45	26	1	43	35	.10	-----	.10	1	3	.0	0	6.5	w.	----	----	---	22	6	3	3.1	--
Pocatello [3]	4,478	5	31	863.5	1,012.9	.0	88	56	71.8	+2.9	99	6	47	26	1	36	31	.21	−.3	.15	3	4	.0	0	7.0	s.	47	w.	24	13	13	5	4.0	79
Ellensburg [3]	1,735	5	58	953.6	1,014.9	-----	82	52	67.2	+.4	98	1	40	26	43	47	52	.27	+.1	.19	2	4	.0	0	13.8	nw.	----	----	---	14	14	3	3.7	--
Spokane [3]	1,929	6	51	946.8	1,015.0	+1.1	82	55	68.6	+.5	96	3	45	8	37	40	38	.19	−.4	.10	5	2	.0	0	6.9	ssw.	29	sw.	9	16	12	3	3.7	83
Walla Walla	991	57	65	978.7	1,013.9	+.4	86	62	74.0	+1.3	99	1	51	14	0	47	--	.06	−.4	.04	2	4	.0	0	5.1	s.	18	w.	7	16	12	3	3.4	80
Yakima [3]	1,076	4	54	975.6	1,014.0	−.2	87	50	68.7	−.5	102	1	41	26	23	47	49	.42	+.1	.30	4	3	.0	0	7.3	w.	----	----	---	15	14	2	3.4	--
NORTH PACIFIC COAST																																			
									64.4	+.5							65	.65	.0														5.3	
Kelso [3]	750	38	76	----	----	----	76	49	62.8	-----	91	28	41	14	93	53	74	.65	-----	.23	4	0	.0	0	5.0	nw.	----	----	---	4	13	14	6.5	--
North Head	211	5	55	1,010.5	1,018.0	−.3	65	55	60.1	+2.5	73	26	50	6	151	----	--	1.08	.0	.28	12	0	.0	0	10.4	n.	37	n.	31	7	9	15	6.6	48
Seattle [4]	125	90	321	1,012.9	1,017.5	+.2	73	56	64.6	−.5	89	1	51	26	42	52	69	.39	−.3	.22	5	1	.0	0	7.8	nnw.	28	s.	15	5	15	11	6.0	48
Tacoma	194	172	201	1,010.5	1,017.3	.0	72	55	63.6	+1.0	92	1	49	26	65	----	--	.34	−.4	.23	6	0	.0	0	7.0	n.	26	sw.	7	7	11	13	6.0	55
Tatoosh Island	86	5	61	1,014.9	1,017.9	−.1	61	52	56.4	+1.1	70	28	49	14	266	53	91	3.05	+1.0	.73	19	0	.0	0	9.6	s.	33	s.	17	2	9	20	7.9	35
Burns	4,162	35	47	873.7	1,013.9	-----	84	49	66.5	+1.9	97	3	40	22	39	37	37	.77	+.5	.70	2	5	T	0	----	----	----	----	---	22	4	5	2.6	--
Eugene [3]	433	4	35	1,003.7	1,017.6	-----	80	51	65.4	-----	94	1	41	13	32	52	67	.08	-----	.04	4	0	.0	0	6.7	w.	----	----	---	9	15	7	4.9	--
Medford [3]	1,329	29	58	968.5	1,015.7	+1.8	86	52	68.9	−2.2	98	1	46	8	7	48	51	.00	−.2	.00	0	0	.0	0	7.9	nw.	----	----	---	19	9	3	2.7	--
Portland, Oreg. [4]	154	68	106	1,011.9	1,017.4	+.8	77	58	67.8	+1.1	95	1	52	13	14	53	67	.15	−.5	.12	4	0	.0	0	5.4	nw.	18	sw.	24	6	16	9	5.7	55
Roseburg	510	45	76	999.0	1,017.3	+1.4	81	54	67.4	−.6	95	1	45	13	16	----	--	.03	−.3	.03	1	0	.0	0	4.9	n.	24	sw.	6	10	14	7	4.4	66

See footnotes at end of table

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR AUGUST 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Temperature of the air: Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover, [7] tenths (sunrise to sunset)	Possible sunshine
MIDDLE PACIFIC COAST	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m. p.h.					0-3	4-7	8-10	0-10	%
									66.9	.0						59	.02	−.1														3.3	
Eureka	60	72	88	1,016.6			63	54	58.7	+2.7	71	6	48	13	193			.02	−.2	.02	1	0	.0	0	6.6		23	sw.	6	6	13	12	6.0	65
Red Bluff [2]	353	5	26	1,000.3	1,012.9		92	62	77.4	−2.3	105	31	56	10	0	47	38	.00	.0	.00	0	0	.0	0	7.2	se.	20	se.	6	27	1	3	1.2	97
Sacramento [4]	66	92	115	1,011.2	1,013.9	+2.0	87	57	72.2	−.7	100	31	53	16	1	52	58	.01	.0	.01	1	0	.0	0	11.5	sw.	22	sw.	9	27	3	1	1.1	93
San Francisco [4]	155	112	132	1,015.2	1,015.9	+1.7	65	54	59.4	+.3	71	21	52	23	175	53	81	.04	.0	.04	1	0	.0	0	17.2	w.	28	w.	4	9	17	5	4.9	59
SOUTH PACIFIC COAST																																		
									73.6	+.1						64	T	.0														2.4	5
Fresno [2]	327	5	34	1,001.7	1,012.2	+1.4	94	60	76.8	−2.7	103	3	54	24	0	50	44	T	.0	T	0	1	.0	0	7.7	nw.	22	nw.	27	26		3	2	1.2	29
Los Angeles [4]	338	236	263	1,010.5	1,014.1	+1.2	84	63	73.7	+2.6	97	27	58	12	0	59	75	.01	.0	.01	1	1	.0	0	6.1	wsw.	18	se.	21	21		9	1	2.6	68
San Diego [2]	87	20	55	1,010.8	1,014.1	+1.2	77	63	70.2	+.4	89	27	59	17	0	60	74	T	.0	T	0	0	.0	0	6.2	wnw.	16	s.	22	14	1	7	0	3.7	70
WEST INDIES																																		
San Juan, P. R.	82	9	54	1,012.5	1,015.2		85	76	80.3	−.2	90	19	73	28	0			4.27	−1.7	1.27	20	7	.0	0	10.9	e.	39	ne.	23	6	15	10	6.3	64
Swan Island	35	6	36																															
ALASKA																																		
Anchorage [3]	132	6	44	1,008.5	1,013.2		64	46	54.8	−.8	76	28	36	15	320	46	74	1.80	−.8	.75	12	0	.0	0		nw.	24	s.	12	3	9	19	7.5	
Annette Island	113	5	53	1,011.9	1,015.9		62	50	56.4	−2.0	78	29	45	12	268	50	84	6.50	+1.9	1.35	16	0	.0	0	8.1	se.				4	7	20	7.5	
Barrow	29	5	27	1,008.8	1,009.1		47	36	41.8	+3.5	63	11	30	13	717	40	90	1.62	+.8	.50	16	0	.0	0	13.9	e.	34	e.	27	0	3	28	9.2	
Bethel [3]	28	5	31	1,008.5	1,009.8		56	46	51.2	−1.1	66	18	38	31	427	48	87	4.42	+.3	.75	21	0	.0	0	12.3	s.				0	0	31	9.6	
Cordova [3]	45	5	32	1,012.2	1,013.9		62	43	52.1	.0	72	3	36	20	401	48	86	4.54	−5.7	2.00	15	0	.0	0	2.7	e.	17	se.	8	5	5	21	7.5	
Fairbanks [3]	455	5	63	994.2	1,011.2		68	43	55.5	+.4	84	29	33	15	295	48	88	1.19	−.9	.42	12	0	.0	0		sw.	25	sw.	1	3	12	16	6.9	
Galena	139	4	66	1,004.4	1,009.1		60	48	54.1	+1.6	68	19	40	14	338	46	75	2.17	−.6	.42	16	0	.0	0	10.3	se.				0	2	29	9.1	
Gambell	32	5	32																															
Juneau [3]	80	6	30	1,013.9	1,014.9		62	44	53.2	+.4	75	30	37	19	369	47	91	3.52	−1.2	.69	15	0	.0	0		n.	24	se.	3	9	6	16	6.4	
Kotzebue [3]	20	5	31	1,006.8	1,007.5		56	47	51.4	+1.4	68	19	41	13	419	48	88	2.21	+.5	.43	16	0	.0	0		se.				0	2	29	9.5	
McGrath [3]	341	5	31	998.3	1,011.2		61	46	53.2	+.3	71	3	38	16	364	47	80	4.36	+.8	.60	21	0	.0	0	6.0	s.				2	3	26	8.8	
Nome [3]	22	10	75	1,006.1	1,006.8		52	46	48.9	−.6	60	8	41	29	498	46	90	6.08	+2.9	.73	24	0	.0	0	12.8	ssw.	42	s.	11	0	1	30	9.8	
Northway [3]	1,718	5	32	950.2	1,012.9		66	45	55.6	+2.8	80	29	40	19	290	45	70	1.06	−1.2	.32	11	2	.0	0	7.5	nw.	24	nw.	9	5	4	22	7.5	
Yakutat	31	5	50	1,013.9	1,015.2		59	46	52.2	−.8	72	29	37	20	400	48	87	7.74	−3.5	2.16	17	0	.0	0		ese.				7	2	22	7.6	
HAWAII																																		
Honolulu [4]	38	86	98	1,017.3	1,017.6		81	73	77.1	−1.3	82	15	71	19	0			.41	−.9	.12	14	0	.0	0	14.2		26	ne.	24	6	17	8	5.6	66

DELAYED DATA FOR JULY, 1949

ALASKA																																		
Anchorage [3]	132	6	44	1,010.2	1,014.9		64	48	56.0	−1.0	78	5	41	1	284	47	74	1.26	−.4	.26	14	0	.0	0	5.0	wnw.	17	s.	31	2	8	21	7.9	
Annette Island	113	5	53	1,013.9	1,018.0		60	50	55.1	−2.5	74	23	44	1	310	49	83	7.02	+1.3	2.01	16	0	.0	0	7.2	se.				0	7	24	8.9	
Barrow	29	5	27	1,013.5	1,014.2		44	32	38.1	−1.7	61	9	28	8	838	34	90	.42	−.4	.27	3	0	T	0	13.7	ene.	32	sw.	3	5	8	18	7.0	
Bethel [3]	28	5	31	1,011.9	1,013.2		61	48	54.6	+.1	78	12	43	2	325	48	81	1.01	−1.3	.34	11	1	.0	0	10.2	s.				2	4	25	8.7	
Cordova [3]	45	5	32	1,014.2	1,015.9		59	43	51.0	−2.0	70	3	35	1	434	48	88	4.47	−.7	.92	20	0	.0	0	2.9	ene.	14	ese.	11	1	6	24	8.0	
Fairbanks [3]	455	5	63	994.6	1,011.5		70	49	59.8	+1.8	85	10	34	1	165	52	79	3.47	+1.6	.58	23	7	.0	0		ssw.	27	sw.	23	1	11	19	7.6	
Galena	139	4	66	1,006.8	1,011.2		69	53	60.8	+.3	80	7	40	1	150	50	70	1.61	−1.0	.69	13	2	.0	0	8.4	sw.				2	10	19	7.5	
Gambell	32	5	32	1,009.5	1,010.5		46	40	43.0	−2.1	53	16	34	1	682	42	96	1.60	.0	.32	12	0	.0	0	12.4	ssw.	40	se.	14	0	0	31	10.0	
Juneau [3]	80	6	30	1,016.3	1,016.9		61	46	53.3	−2.2	75	4	38	3	363	46	82	3.97	−.2	.90	19	0	.0	0		n.	22	se.	4	0	8	23	8.7	
Kotzebue [3]	20	5	31	1,011.2	1,011.5		59	46	52.7	−.3	77	14	36	1	387	48	83	.65	−.8	.35	8	0	.0	0		w.				5	5	21	7.5	
McGrath [3]	341	5	31	1,000.3	1,012.9		68	49	58.3	−.2	81	6	39	3	211	48	74	1.87	−.5	.44	12	2	.0	0	5.5	ssw.				3	3	25	8.1	
Nome [3]	22	10	75	1,011.9	1,012.5		53	44	48.5	−1.4	67	11	37	1	513	46	91	1.23	−1.3	.32	13	0	.0	0	10.3	wsw.	31	e.	14	0	4	27	9.3	
Northway [3]	1,718	5	32	950.6	1,013.2		67	47	57.3	−1.7	86	9	36	3	243	47	76	5.05	+2.2	1.44	19	6	.0	0	5.0	nw.				2	5	24	8.2	
Yakutat	31	5	50	1,015.9	1,017.3		56	47	51.5	−1.5	70	9	40	9	416	48	88	9.09	+.9	2.01	14	0	.0	0		e.				2	3	26	8.9	

[1] Height of barometer cistern above mean sea level on Jan. 1, 1900, or when station was first established since Jan. 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations according to note 1.

[3] Barometric hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records, remainder from city office records.

[6] Barometric, temperature, degree day, and hygrometric data from airport; remainde from city office records.

[6] As of Jan. 1, 1949, relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after Jan. 1, 1949, cannot accurately be combined without necessary conversion.

[7] As of Jan. 1, 1949, "Sky cover" has been substituted for "Average cloudiness" to include smoke, snow, etc., in addition to clouds that obscure the sky.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE STORMS FOR AUGUST 1949

[The table hereunder contains such data as has been received concerning severe local storms that occurred during the month.]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Beulah, Colo	1	2-3 p. m	13		$1,000	Hail	Hailstones 1/6 to 1/4 inch in diameter damaged hay.
Shippensburg, Pa	1	Afternoon				Electrical	Large barn struck by lightning. The resulting fire destroyed hay, straw, 550 bushels of barley, 500 bushels of wheat, farm machinery including a corn binder, and also a milk shed.
Crab Orchard, Lincoln County, Ky.	2	2-2:30 p. m				Hail and rain	Some fields of tobacco a total loss.
Science Hill, Ky	2	2:15-3:15 p. m				Wind and hail	Hail damaged tobacco; some fields a total loss. Corn blown down by wind.
District of Columbia	2	4-6 p. m				Rain	More than 3 inches of rain fell over a small area in about 2 hours. 2 automobiles collided due to mud which had washed onto paved street. Newspapers reported automobiles floating down streets. Streets and basements flooded. Most severe in Brightwood and Takoma Park areas.
Buffalo (near Kershaw), S. C.	2	Afternoon		1		Electrical	1 person killed by lightning.
Belt (west of), Mont	2	8:45 p. m	1 1			Hail	Moderate hail caused up to 50 percent damage in some spots over path 5 miles long.
Daviess County, Ind	3	3 p. m	1 1		21,000	Wind and hail	Hailstones up to 1 inch in diameter occurred south of Washington. $20,000 crop damage included in total.
Monte Vista, Colo	3	4:30-7:30 p. m	1 4		5,000	do	Storm most severe in small area northwest of Monte Vista. Hailstones 1/2 inch in diameter and wind velocities 30 m. p. h. Damage limited to crops and trees.
Idaho, (south-central portion).	3	8:30-11 p. m				Wind and electrical	Strong winds and severe lightning accompanied numerous thunderstorms at Twin Falls, Jerome, Lincoln. Wind damage apparently light, despite gusts to 60 m. p. h. at Twin Falls. Considerable interruption of power, and damage to power lines. 9 head of cattle killed by lightning.
Carbondale and vicinity, Colo.	4	3:30-4:30 p. m	1 2		8,000	Wind, rain, and hail	Some damage to crops by wind-driven rain and hail, but greatest losses to power and telephone lines. Storm swept 13-mile stretch between Carbondale and Basalt.
Quarryville and Christiana, Pa.	5	Morning				Electrical and flash flood.	Man knocked down by bolt of lightning while entering store; another flattened against kitchen wall of his home by lightning bolt. A $15,000 barn destroyed by lightning fire. Tobacco and corn fields damaged by washing. Water covered highways in New Providence area, impeding traffic for several hours.
Buckeye-Gila Bend area, Ariz.	5-6	Morning 5th to evening 6th	1 20		10,000	Thunderstorms, with rain and wind.	Flash floods from Maricopa Mountains caused extensive damage to Highways 84 and 80 east of Gila Bend. Flood waters broke into full canal, crossed canal, and caused 3 breaks in highway. Centenial Wash ran 4 1/2 feet deep across highway. High winds ripped down 40 telephone poles between Maricopa and Gila Bend.
Connecticut, (northeastern portion).	6	3:30-5 p. m			3,000	Electrical, wind, and rain.	Lightning, squalls, and heavy rains damaged crops, signs, and trees, and killed livestock. Most damage in Windham County.
Lake City, S. C	6	7:30 p. m			3,000	Electrical	Lightning fires burned 2 barns, killing 2 mules.
Timmonsville, S. C	6	8 p. m		1		do	1 person killed by lightning.
Truchas, N. Mex	6	11 p. m				Hail	Extensive crop damage and many windows broken.
Mesa-Phoenix area, Ariz	6	Evening	1 30	3	100,000	Thunderstorms, with rain and winds.	Highest winds in Tempe-Mesa sector, but strong as far west as Phoenix. Power lines flattened and more than 5,000 telephones out of order for nearly 24 hours. Woman killed in Mesa, when house collapsed. Pilot killed by lightning near Queen Creek, while staking down plane. A third person perished when his house burned, due to short circuit from wire blown on building. Extensive damage to homes and business buildings in Tempe-Mesa area. Warehouse moved from foundation by strong wind. Hangar at Tempe demolished by wind. Wind blew off roofs and caved in walls of several buildings over entire width of path. 10,000-gallon gasoline tank toppled by wind in Mesa.
Liberty County, Mont	7	Afternoon	880			Hail	Moderate hail caused 33 percent loss to wheat.
Cayce, S. C	7	do			5,000	Electrical	Fire from lightning destroyed dwelling.
Arizona (northeastern portion).	7-8	Evening and next day.			10,000	Thunderstorms and rains.	Series of heavy thundershowers in Showlow-Holbrook area and in McNary-Springerville sector caused many flash floods in canyons and draws. A 75-foot fill on State Highway 77, near Shumway washed out. The Little Colorado River near Holbrook ran nearly bankfull. Considerable washing on county roads over entire sector. A portion of Apache Railroad between McNary and Snowflake washed out by flash flood.
Howell (near), Mich	8	3-5 a. m			40,000	Electrical	In area 3 to 5 miles northeast of Howell, 3 farms struck by lightning. Resulting fires destroyed 3 barns and contents, also 2 smaller buildings.
Macon, Ga	9	7 p. m				Electrical, rain, and wind.	3 inches of rain in about 1 hour flooded streets to depths of 2 to 4 feet or more; 1 residential area flooded to extent that 33 residents had to be evacuated. Railroad tracks underwashed near Terminal Station, and in 1 place a hole 20 feet in depth was left. Portion of roof of business house caved in, injuring 1 person and severely damaging an automobile and other property. More than 1,000 telephones out of order. Lightning struck at several points, causing minor damages. Trees blown down in 1 section. Amount of losses not known, but probably at least $10,000.
Long Prairie and vicinity, Minn.	9	p. m			5,000	Electrical	Barn struck by lightning and entirely destroyed by fire. An adjoining silo also burned. 4 calves perished.
Imperial (8 miles southwest of), Tex.	10	3 p. m	880			Hail	From 20 to 70 percent of damage to crops.
Missoula, Mont	10	Afternoon				Wind	Wind, reaching peaks of 70 to 80 m. p. h. did considerable damage. Large shade trees snapped off, a hangar demolished, power lines broken and service disrupted over city and Fort Missoula. Screen of drive-in theater blown down, causing loss of $7,000. Damage of $10,000 in Intermountain Lumber Co. yards.
Levelland, Tex	10	7:30 p. m	1 2		310,000	Wind and hail	Damage to crops from hail, $300,000; damage to buildings from wind, $10,000. Complete loss of cotton, feed, and other crops in path 10 miles long.
Waukegan area, Ill	10	9 p. m			3,000	Rain and wind	Many basements and streets flooded; several power lines downed.
Eastern Clinton and Scott Counties, Iowa.	10-11	5 p. m.-10 a. m		2		Rain and electrical	At Davenport, 6.57 inches fell in 24 hours, greatest 24-hour total ever recorded in 76 years. 24-hour totals at Moline, Ill. and Clinton, Iowa, were 4.44 inches and 3.69 inches, respectively. An estimated damage of one million dollars in the Quad-City area. Most loss from flooding of business buildings, factories, residences, and autos. Duck Creek overflowed, causing considerable damage. 1 boy killed by lightning, and another drowned in drainage ditch.
Dodgeville (near), Wis	11	2 a. m				Electrical	Barn containing 3,700 bales of hay burned, and house and cheese factory partly burned, when struck by lightning.
Moline-Rock Island areas, Ill.	11	5 a. m		1	1,000,000	Rain	Many homes, stores, and factories severely damaged by flooding. Over 7 inches of rain fell at Rock Island, and nearly 4 1/2 inches at Moline Airport. Boy drowned in flooded drainage ditch, and woman injured in storm.

See footnote at end of table.

SEVERE STORMS FOR AUGUST 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Southeastern Connecticut, central and southern Rhode Island.	11	10 a. m.–1 p. m.			$30,000	Electrical	2 large barns in Richmond, R. I., destroyed. Numerous buildings damaged by lightning on east side of Narragansett Bay. In New London, Conn., 5 buildings struck.
Decatur County, Ind.	11	Noon			1,000		Minor building damage in Marion Township. Nearly all damage was to crops.
Logan County (southern and eastern portions), Ill.	11	12:15 p. m.			2,000	Rain and wind	Trees damaged; many telephone lines downed.
Collinsville area, Ill.	11	12:45 p. m.				Wind and hail	Many trees damaged; some uprooted.
Wiggins, Miss.	11	3:45–4 p. m.			10,000	Wind	Several houses damaged, and a number under construction blown down.
Bethel, Conn.	11	4–5 p. m.		0		Tornado	Described as small "twister." Passed through sparsely settled small area; destruction of several large trees only damage.
Helena, Mont.	11	5:55–6:10 p. m.			500	Wind	Large tree uprooted, sign boards blown over, and small frame building demolished. Peak of 59 m. p. h. reached.
Des Moines, Iowa	11	5:40–8:06 p. m.				Rain	Record breaking downpour of 3.44 inches in 2 hours. Some gusty wind accompanied rain, but most damage caused from excessive water.
Williamston and vicinity, N. C.	11	6 p. m.			16,000	Hail	$14,000 damage to crops, $2,000 to other property.
New Orleans, La.	11–12	11 p. m.–1 a. m.			10,000	Electrical and wind	2 severe electrical storms. Trees uprooted by high winds; transformers put out of commission, interrupting operations at factories, public transportation, etc.
Gallatin County, Mont.	12	5 a. m.	[1] 2		6,000	Hail	Hail caused considerable damage to winter and spring wheat.
Tarpon Springs, Fla.	12	8:25 a. m.	35	0	100	Tornado	Storm "bounced" along for mile or more in northeastward direction through sparsely settled area, causing slight damage to home, interrupting telephone service, and breaking trees. Funnel cloud had foggy appearance and was accompanied by sounds resembling exhaust of a jet propulsion engine.
Liberty County, Mont.	12	1:30 p. m.	[1] 1½		10,000	Hail	5 to 50 percent damage to wheat.
Richey, Mont.	12	2:30 p. m.	880		500	Wind	Hangar destroyed.
Medicine Lake, Mont.	12	3:30–5:30 p. m.	1,320			Hail	Heavy hail, some 1¼ inches in diameter, did considerable damage over path 15 miles long; some fields completely destroyed. Damage was to wheat, barley, cane, and corn.
Choteau, Mont.	12	5 p. m.	[1] 1½		8,000	do	15 to 25 percent damage to crops.
Baltimore and vicinity, Md.	12	6:45 p. m.				Wind	Trees and poles blown down. Several trees fell on parked automobiles. Store windows smashed.
Armour, S. Dak.	12	7:15 p. m.				Rain and wind	Strong winds accompanied a 3.13-inch rain and caused falling of trees and damage to power lines and weaker buildings.
Lustre, Mont.	12	7:15–7:40 p. m.	[1] 2–3		25,000	Hail and wind	50 to 90 percent damage to corn and wheat.
Anne Arundel County, Md.	12	8 p. m.		1		Electrical	Woman killed by lightning while sitting in kitchen; electrical fixtures in ceiling of each room torn out, leaving gaping holes.
Finney County, Kans.	12	Evening		0		Tornado	Tornado moving northeastward struck ground about ¼ mile south of river on Highway 83. 2 buildings and 2 automobiles damaged.
Worcester County, Md.	12					Electrical	Light plane struck while in flight, forcing it to ground. A large hole torn in wing.
Harford County, Md.	12					do	Barn struck by lightning and burned.
Calvert County, Md.	12					Hail and electrical	2 farmers reported at least 75 percent of tobacco crop damaged, while others reported lesser damage. Horse killed by lightning.
Pottawatomie County, Okla.	13	11 a. m.–12:15 p. m.	220	0	3,760	Tornado, hail, and electrical.	Storm area 6 miles north of Shawnee to 8 miles north and 1½ miles east. Tornado destroyed or damaged several outbuildings; loose material blown away or twisted around trees. Path of tornado only about ½ mile long, and occurred 6 miles north of Oklahoma Baptist University. Lightning struck a hay barn north-northeast of Shawnee about 12:15 p. m., with a loss of about $3,000.
Hampden County, Mass.	13	Forenoon			100,000	Rains	At Springfield, Chicopee, Holyoke and other cities and towns in Connecticut Valley 2 to 3½ inches of rain in as many hours caused washouts, soaked industrial and merchandise stocks, disrupted power lines, flooded cellars, and disabled automobiles.
Norborne, Mo.	13	Late afternoon.		1		Electrical	2 children struck by lightning, when removing clothes from a line attached to a tree which was struck by lightning; 1 killed.
Roosevelt County, Mont.	13	9:30 p. m.	[1] 2		42,000	Hail	Damage to wheat.
Lavalette and vicinity, W. Va.	14	Afternoon				Rain and electrical	Cloudburst caused about a 3-mile stretch of Long Branch Creek to overflow its banks and flood adjacent hay and corn fields; small footbridge washed out. Lightning struck residence in Lavalette, causing slight damage.
Sedan and vicinity, N. Mex.	14	5:30 p. m.				Hail	50 to 90 percent crop loss.
Elliston and vicinity, Greene County, Ind.	14–15				27,000	Flash flood	Damaged bridges, fields, and crops. $10,000 crop damage included in total.
Yuma and vicinity, Colo.	15	11 a. m.–2 p. m.	[1] 4		2,500	Hail	Storm in Schramm, Yuma, and Otis sections. Hailstones ¼ to ¾ inch in diameter. Damage mostly to growing crops.
Eastern Lewis and western Upshur Counties, W. Va.	15	Morning and afternoon.			20,000	Rain	Flash floods in smaller streams washed out many small bridges and damaged roads; several houses flooded; with 1 washed away from foundation; considerable damage to crops in lowlands. Worst flood in 22 years at Valley Chapel.
Ravalli County, Mont.	15	1–2:30 p. m.	[1] 1		2,500	Hail	Damage to barley, oats, and wheat.
Rapid City, S. Dak.	15	2:35–3:15 p. m.	[1] 2		25,000	do	Path about 5 miles long and 2 miles wide, but main part of storm only about 2 miles long and ½ mile wide. West end of Rapid City, known as Canyon Lake district, hardest hit. Precipitation measurements varied from 3½ to 4½ inches in west end to near 2 inches in center of town. Hail measured 6 inches deep in truck box that had straight sides. Ice on some hills caused them to be white for more than 12 hours after storm. Some ice covered with dirt, etc., reported to be unmelted 4 days later. Greater part of damage to roofs and flooding of basements.
Fort Worth, Tex.	15	Afternoon			10,000	Wind	8 airplanes damaged and small building destroyed.
Frontier County (northern border of western portion), Nebr.	15	4:30 p. m.	[1] 2–3			Hail	Corn badly damaged in path 20 miles long.
Lamesa, Tex.	15	5:30 p. m.	[1] 1		225,000	do	5,000 acres of cotton damaged.
Daniels County, Mont.	15	6 p. m.	[1] 1		30,000	Hail and wind	Damage to wheat, barley, oats, and flax. $20,000 hail damage and $10,000 wind damage.
Valley County, Mont.	15		[1] 2–10		12,000	Hail	Spotted damage to wheat over path 18 miles long.
Cheyenne County, Kans.	16	3:30 p. m.	[1] 6		105,000	do	Storm traveled 8 miles from Wheeler to Bird City. Trees stripped of leaves; gardens, row crops, and some property damaged. Hail generally size of marbles.
Eastern Jackson and western Martin Counties, Minn.	16	5 p. m.	[1] 5	70,000		Thundersqualls and hail.	A number of barns, houses, and grain elevators damaged; outbuildings and silos wrecked; poles and wires down; trees uprooted. Light to heavy hail caused $50,000 damage to growing crops, mostly to corn and soybeans, included in total.
Wisconsin Rapids, Wis.	16	Afternoon				Rain and electrical	Torrential thunderstorm rains flooded portions of city. Some telephone and power lines damaged by lightning.
Berlin (near), Wis.	16	7:15 p. m.		2		Electrical	Struck by lightning.
Lancaster and Saunders Counties, Nebr.	16	7:10–7:30 p. m.	[1] 40		10,000	Thunderstorms and wind.	Damage to wires interrupted telephone service; minor damage to trees Storm path 40 miles long, with principal damage from Lincoln to Wahoo.
Sherman and Thomas Counties, Kans.	16	8 p. m.	[1] 3		20,000	Hail	Hail fell over path 20 miles long, with heaviest damage in vicinity of Brewster. Main loss to growing crops, buildings, and automobiles.

See footnote at end of table.

SEVERE STORMS FOR AUGUST 1545—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Columbia, S. C.	16–17	Night			$25,000	Rain	Record rain of 7.40 inches in 24 hours caused considerable damage by flooding streets and cellars, washing out nearby country roads, and flooding small bridges and low places.
Aztec, N. Mex.	17	11:45 a. m.				Hail	Fruit and truck crops damaged.
Wauseon, Ohio	17	2:10–3:10 p. m.				Rain	2.30 inches of rain fell in 1 hour, flooding basements.
Lewistown, Mont.	17					Hail	Severe loss of grain.
Unionville and vicinity, Mo.	17	Night			3,000	Electrical	3 cows killed by lightning. Barn and contents burned when struck by lightning.
Rushville, Mo.	18	Late afternoon				Hail	Hailstones up to 2 inches in diameter caused heavy damage to tobacco and corn crops.
Rice and Reno Counties, Kans.	18	9–11 p. m.				Wind	Path of damage extended from near Chase in western Rice County southeastward about 30 miles to near Hutchinson. Numerous windows blown in near Chase. Power and telephone lines blown down and damaged by falling tree limbs.
Shawnee County, Kans.	18	Evening				Wind, hail, and electrical.	Northwest winds broke many limbs and telephone and power lines in and around Topeka. Hail, size of hen eggs and very jagged and rough, fell east and north of town, damaging airplanes, greenhouses, crops, and knocking window lights out of houses. Several homes struck by lightning.
Payne County, Okla.	18			1		Electrical	Farmer sitting in living room killed by lightning which struck wiring of house.
Casino Creek, Mont.	19	Afternoon	[1] 3–4			Hail	Considerable damage to wheat over path 5 miles long.
Clyde Park, Mont.	19	4:30 p. m.	[1] 1		8,000	do	Damage to grain over path 3 miles long.
Musselshell County, Mont.	19	5:30 p. m.	1,320			do	Moderate hail destroyed 37 percent of barley over path 6 miles long.
Golden Valley County, Mont.	19	6:45–7:45 p. m.	1,320		3,000	do	Damage to wheat over path 4 miles long.
Fernandina, Fla.	20	2:30 p. m.		1		Thunderstorm	High seas swept boy from jetty into deep water where he drowned.
Dallas, Hale, Marengo and Perry Counties, Ala.	20	2:30–3 p. m.			1,500	Thundersquall	At Sardis, barn damaged and mule killed, loss $400. Craig Field at Selma reported gusts up to 69 m. p. h. Other minor wind damage to buildings, and damage to trees and telephone lines over area extending westward over portions of Hale, Marengo, and Perry Counties.
Gallatin County, Mont.	20	3:30 p. m.	880–1,320		600	Hail	Spring wheat damaged.
Cimarron, N. Mex.	20	5:30 p. m.			100,000	do	Crop loss about $50,000, with equal damage to roofs and windows.
Huron, S. Dak.	20	6–6:30 p. m.				Wind	Winds, above 70 m. p. h. at times, wrecked hangar and airplane at municipal airport. Trees, power, and telephone lines damaged.
Porthill, Idaho	20	6:45 p. m.				Hail	Damage small.
Mobile, Ala.	20	Early night		4		Thundersquall	Small skiffs overturned drowning 4 men in Mobile Bay.
Eldorado (5 miles south of), Okla.	20				700	Wind	Peach orchard severely damaged.
Wibaux (north of), Mont.	20		[1] 8		35,000	Hail	Hailstones up to 1 inch in diameter damaged wheat over path 12 miles long.
Warren County, N. C.	21				85,000	Wind	$50,000 damage to corn, cotton, and tobacco. $35,000 damage to buildings in Manson area.
Cascade County, Mont.	23	3 p. m.	[1] 6		75,000	Hail	Light to 100 percent loss over path 15 miles long.
Park County, Mont.	23		1,320		15,000	do	Damage over path 20 miles long.
Dare County, N. C.	24	Morning		1		Hurricane	Several houses unroofed. Thousands of trees broken in Buxton area. Man drowned in Croatan Sound. Estimated damage of $50,000 to housing in Buxton.
Raton, N. Mex.	25	Noon				Rain and hail	Some local flooding and erosion. Hail damaged gardens.
Raymond and vicinity, Minn.	25	4:15 p. m.	[1] 6		7,000	Thundersqualls (possibly small tornado).	Several farm outbuildings demolished; hayrack wrecked and farm machinery damaged; large chimney of town garage toppled; poles, wires, signboards down; many trees uprooted.
North of Stockville to north of Eustis, Nebr.	25	7:30–7:45 p. m.	[1] 2		110,000	Thundersquall and hail.	Moved northeastward in path 30 miles long. Forage feed a total loss. Damage of $100,000 to corn and forage, and $10,000 to roofs of buildings.
Florida, east of Longitude 84° W. except Gulf Coast Counties south of Sarasota.	26–27			2	45,000,000	Hurricane	Center reached Florida coast at Delray Beach, a few miles south of West Palm Beach about 6 p. m. the 26th, with winds reaching 153 m. p. h. at Jupiter Lighthouse before the anemometer failed. Storm curved slowly to right and center passed across northern part of Lake Okeechobee, then northwesterly across Highlands and Hardee Counties, and over Plant City to Gulf Coast in Citrus County by noon 27th. From Citrus County storm center moved northward, passed a few miles west of Lake City about 7 p. m. and was near Valdosta, Ga. at 10 p. m., with winds from 40 to 70 m. p. h. to north and east of the center. Heaviest crop losses suffered by citrus, particularly grapefruit, in Indian River and Ridge areas. Avocado losses heavy in Lake Placid, Avon Park, and Auburndale areas. Loss of truck crops largely confined to seedbeds. ESTIMATED DAMAGE SUMMARY Crops, all kinds (includes 14,000,000 boxes of citrus) $20,000,000 Property 18,000,000 Power and communications 4,000,000 Highways, bridges, and streets 500,000 Miscellaneous (includes trees, shrubs, fences, and a few small craft) 2,500,000
Welch and vicinity, Minn.	27	4:40 a. m.			6,300	Thundersqualls	Town garage partly demolished; buildings damaged; 2 windmills wrecked; poles and wires down; some trees uprooted; hundreds of sparrows perished.
Lincoln area, Ill.	27	7:15 p. m.			3,000	Wind and rain	Several trees blown down; utility and communication lines damaged. Many basements flooded.
Valdosta to Augusta, Ga.	27–28	Afternoon to early morning.		1		Hurricane	Incomplete reports indicate losses of $300,000 or more, possibly as great as $500,000. Many areas sustained light to moderate damages, with losses of $35,000 known to have occurred in Valdosta area, more than $25,000 in Brunswick area, and $250,000 in Savannah area. Much corn blown down and pecans blown off trees in Valdosta area where maximum wind 55 m. p. h. and a low pressure of 29.2 inches m. s. l. Winds at Brunswick reached 75 m. p. h. (estimated), and rainfall amounted to 8.68 inches within 24 hours, two-thirds of which fell during the early morning hours of the 28th. Crops and fields inundated and badly washed; much damage to roadways, also to power and communication lines. Only slight to moderate damage to trees and buildings. One-third of damage in Savannah area involved crops. Many trees uprooted or broken off, with resultant damages to automobiles and other property from falling trees or limbs; considerable roof and slight structural damage to buildings. Most damage to crops, due to heavy rains, the beating effect, and resultant flooding. 1 person killed, due to contact with "live" wire.
South Carolina (northwestern portion).	28	Morning			1,500,000	do	Damage to property, communications, and roads roughly estimated at $500,000. Crop damage consisted mainly of ungathered corn and hay blown down in bottom lands, and further aggravation to cotton; will probably exceed $1,000,000.

See footnote at end of table.

SEVERE STORMS FOR AUGUST 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Scotland County, N. C.	28	Noon		0		Tornado	Struck parts of county. Trees blown down and houses damaged. Approximately $35,000 damage to buildings and machinery of Morgan Cotton Mills at Springfield.
Asheboro, N. C.	28	Afternoon				Wind	Antenna tower of Radio Station WGWR blown over.
Granville County, N. C.	28	do			$76,000	do	$36,000 damage to property and $40,000 to crops.
Wilson, N. C.	28	do			30,000	do	3 radio towers blown down.
Virginia	28	Afternoon and night.			200,000	Wind and rain	Remnant of the hurricane caused considerable minor damage to trees, power lines, and light buildings over most of State, but principal damage concentrated in Sussex and Richmond Counties. At Wakefield 3 houses destroyed beyond repair, and at Mothershead Neck and Holes Point 1 house wrecked and 3 summer cottages damaged.
Raleigh, Apex, and McCullers areas, N. C.	28	4 p. m.		0	60,000	Tornado	Power and communication lines down. Several buildings including houses damaged. Many trees uprooted or broken.
Franklin County, N. C.	28	5 p. m.		0	100,000	do	1 residence destroyed, 5 others damaged; 25 tobacco barns leveled or badly damaged. Numerous other buildings damaged. 3 persons slightly injured.
Birmingham, Ala.	28	5 p. m.	880		150,000	Electrical, wind, and rain.	6 C-46 Air Force planes damaged at Municipal Airport; 3 civilian planes also damaged. Some trees blown down, with power lines broken. Storm moved southeastward, covering area about ½ mile square. $22,500 damage by lightning; $112,500 by wind; $15,000 by rain.
Ridgeway and vicinity, N. C.	28	5:30 p. m.		0		Tornado	Trees, farm buildings, and crops damaged or destroyed. Some livestock and poultry killed or injured.
Coos and Grafton Counties, N. H.	28-29	Night and all day.				Rain	2.0 to 3.6 inches of rain fell throughout mountain area of New Hampshire, causing washout damage.
Maryland (central and eastern portions).	28-29	During night.				Wind	Remains of tropical hurricane. Boats ripped loose from moorings at Crisfield and Essex. In Worcester County at 2 farm homes whirlwinds tore off chimney, knocked out window panes, and flatted outbuildings, including a work shop, barn, and poultry house containing 100 chickens and 15 hogs. 300 telephones out of order in Worcester County. Trees and power poles downed; some on parked automobiles. Damage estimated at several thousand dollars. In Baltimore City, 2 policemen injured; at least 15 large plate glass windows (valued at from $75 to $150 each) smashed, and 2 large neon signs shattered. In several sections of city, electricity off for some time.
Laurel, Del.	28-29	During night.				do	Large storage building and 2 broiler houses blown down. Unoccupied farm house moved from its foundation. In many parts of Peninsula, the wind left a path of broken woodland.
Connecticut, Rhode Island, and Massachusetts Coasts.	29	Morning and early afternoon.			25,000	Rain, wind, and tidal damage.	Storm, of tropical origin, maintained considerable energy during its northeastward passage, causing heavy rains in southern New England; strong south-southeast winds on southern coast pushed noontime high tide 2 to 3 feet above normal in bays and inlets, causing small-craft damage, and eroding coastal roads, beaches and sea-walls.
Sandusky, Ohio.	29					Thunderstorm	Considerable damage in southeastern suburban section of city.
Birmingham, Ala.	30	10:30–11 a. m.	880			Thundersquall	Slight wind damage, but flooding of stores, basements, and automobiles in downtown area caused damage of $350,000. Storm moved east-southeastward for 7 miles.
Grant (near), Mich.	30	11–11:30 a. m.	34–67	0	10,000	Tornado	Storm started 1 mile north of Grant and moved nearly straight east for about 3 miles. Funnel-type cloud preceded by ½ inch hail and heavy rain. Small buildings blown down and crops destroyed.
Red Bud area, Ill.	30	4 p. m.			5,000	Wind and hail	Hail caused light damage to several automobiles; some corn stripped.
Montgomery, Ala.	30	4:20 p. m.	10–17	0	3,300	Tornado	On Dalraida road east of Montgomery and ½ mile south of Gunter Field, tornado, moving south-southeastward, hit ground at just one spot where a house was standing. Roof and most of ceiling lifted away and scattered over an area 200 yards long by 100 yards wide, fanning out from the house in the direction of the storm: damage $3,000; also $300 damage to greenhouses and nursery stock which it passed over.
Des Moines, Iowa.	30	Afternoon				Hail	Hailstones up to 1 inch in diameter fell in area of Polk County Farm, section of Highland Park and Norwoodville, and in vicinity of State Fair Grounds.
Willoughby and vicinity, Ohio.	30					Wind	Trees and public utility lines blown down.
Kearney, Finney, and Grant Counties, Kans.	31	6–7 a. m.			60,000	Hail and wind	Violent wind over southern Kearney, eastern Finney, and northern and eastern Grant Counties. Hail damaged crops and property in various small strips. Storm from northwest. Hail ranged in size from peas to marbles and most severe at Ulysses and eastward.
Elliston, Greene County, Ind.	31	Noon	[1] 3		8,000	Wind and hail	Hail up to ½ inch diameter. Damage to crops.
Lexington, Fayette County, Ky.	31	1:25–1:45 p. m.	[1] 1		100,000	do	Path 3 miles long. Hailstones from ¼ to ¾ inch in diameter, and mainly chunks of clear ice. Area of damage between the Frankfort and Versailles Pikes and extending from vicinity of Bluegrass Field to about 3 miles eastward. Tobacco only crop damaged to any extent.
McHenry and Lake Counties, Ill.	31	3 p. m.				do	Many trees damaged and some corn flattened.
Ruidoso, N. Mex.	31	3:30 p. m.			500	Hail	Windows and roofs damaged.
Isconsi : (southern portion)	31	Afternoon		2		Wind and hail	Sudden and severe windsqualls accompanying cold front as it moved eastward, caused considerable property damage. Power and telephone service disrupted, several silos razed, and barns unroofed. Small boats on Lake Michigan and inland lakes sunk or damaged. Several tents at Walworth County fair blown down. Signs, windows, tree limbs, and telephone and power wires in Milwaukee and other cities broken. Many apples whipped from trees. Some destruction to crops, gardens, and fruits by large hailstones near Thiensville, Mather, Madison, and in Walworth County. 1 person drowned; another electrocuted by fallen "live" wire.

LATE REPORT FOR JULY 1949

Dodge and vicinity, Nebr.	31	10–10:30 p. m.	[1] 1		$16,000	Hail	$12,000 damage to corn and other crops, and $4,000 to roofs and windows in path 6 miles long. Hailstones averaged about 1 inch in diameter.

[1] Miles instead of yards.

SOLAR RADIATION DATA FOR AUGUST 1949

Explanation of tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the MONTHLY WEATHER REVIEW, volume 72, No. 1, January 1944, page 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in table 1 appears in volume 75, No. 3, March 1947, page 47.

TABLE 1.—*Solar radiation intensities during August 1949*

[Gram calories per minute per square centimeter of normal surface]

MADISON, WIS.

Date	Sun's zenith distance: A.M. 78.7°	75.7°	70.7°	60.0°	0.0°	P.M. 60.0°	70.7°	75.7°	78.7°	Vapor pressure: 7:30 a.m.[1]	1:30 p.m.[1]
	Air mass: 4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
August										*mb.*	*mb.*
2	0.79	0.88	0.99	1.15	1.33	1.03				15.3	17.0
3				.98	1.38					15.3	14.8
4	.69	.77	.91	1.04	1.26	1.01				15.3	14.2
5	.35	.48	.58	.76	1.16					15.8	16.5
8	.50	.59	.73	.90	1.14	.92				23.4	25.0
9	.52	.64	.77	.95	1.19	.95				24.2	21.8
15	.30	.36	.49	.66	1.15	.90				21.1	19.6
19	.70	.81	.94	1.10	1.20	1.01				14.2	14.8
22	.74	.83	.94	1.03	1.21	.98				12.3	14.8
24	.44	.54	.69	.90	1.20					16.5	19.0
25		.55	.66	.87	1.10					19.0	19.0
26	.32	.38	.44	.50						19.0	21.1
29	.75	.88	.98	1.14	1.38	1.11				11.0	10.2
30					1.33	1.08				14.8	14.2
Means	.55	.64	.76	.92	1.23	1.00					
Departures	−.09	−.10	−.11	−.13	−.07	−.04					

TABLE MOUNTAIN, CALIF.

	Air mass: 3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
August										*mb.*	*mb.*
8	1.13	1.22	1.32	1.44							
9				1.43							
10				1.44							
11				1.41							
13				1.43							
14				1.42							
15	1.11	1.20	1.30	1.42							
16				1.46							
17				1.44							
18				1.43							
19				1.46							
24				1.46							
29	1.19	1.27	1.36	1.47							
31				1.48							
Means	1.14	1.23	1.33	1.44							
Departures	.00	+.01	+.01	+.03							

TABLE 1.—*Solar radiation intensities during August*—Continued

BLUE HILL, MASS.

Date	Sun's zenith distance: A.M. 78.7°	75.7°	70.7°	60.0°	0.0°	P.M. 60.0°	70.7°	75.7°	78.7°	Vapor pressure: 7:30 a.m.[1]	1:30 p.m.[1]
	Air mass: 4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
August										*mb.*	*mb.*
5						0.77				20.0	20.7
6			0.49							18.7	15.0
7	0.44	0.49	.66	0.82						21.5	17.6
8							0.58	0.43	0.34	19.1	17.5
10	.56	.66	.79	1.04		.91			.51	20.0	13.4
14						1.16	1.01	.88	.80	16.9	15.8
16	.77	.89	1.03							17.6	11.3
17								.53		15.7	13.7
19							.95	.89	.85	15.8	11.1
20	.88	1.00	1.14	1.22		1.22	1.07	.96	.85	10.6	7.7
21	.85	.96	1.08	1.25	1.43	1.22	1.02	.87	.77	10.9	7.9
22	.83	.92	1.06	1.21						11.1	11.2
25	.82	.91	.97	1.03	1.35	1.01	.65			11.3	9.4
26	.29	.62	.75	.94	1.14	.90	.74			13.9	15.4
27	.39	.59	.69			.70	.42	.26	.18	21.1	19.1
28	.39	.46	.77							24.7	20.8
30							.81	.62	.54	15.6	15.8
Means	.62	.75	.86	1.07	1.31	.99	.81	.68	.60		
Departures	−.02	−.02	−.02	+.03	+.01	−.03	−.03	.00	+.01		

LINCOLN, NEBR.

	Air mass: 4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
August										*mb.*	*mb.*
22				0.92	1.20	0.92	0.73	0.60	0.50	14.6	17.7
23				.99	1.26	.99	.79	.67	.56	13.7	17.7
24				.99	1.26	.99	.82	.67	.56	14.2	16.4
25			0.75	.92	1.24					16.4	16.4
30			.88	1.03	1.29	1.12	.97	.84	.71	16.4	13.7
31					1.32	1.10	.94	.79	.67	13.7	8.4
Means			.82	.97	1.26	1.02	.85	.71	.60		
Departures			−.08	−.11	−.04	−.03	−.01	−.02	−.02		

* Extrapolated.
[1] 75th Meridian time.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct + diffuse) received on a horizontal surface during August 1949*

[Gram-calories per square centimeter]

Date	Honolulu, T. H.	Pearl Harbor, T. H.	La Jolla, Calif.	Riverside, Calif.	Nashville, Tenn.	Fresno, Calif.	Davis, Calif.	Washington, D. C.	Columbia, Mo.	Soda Springs, Calif.	Seabrook, N. J.	Grand Lake, Colo.	New York, N. Y.	Salt Lake City, Utah	State College, Pa.	Lincoln, Nebr.	Newport, R. I.	Put-in-Bay, Ohio	East Wareham, Mass.	Blue Hill, Mass.	Boston, Mass.	Lynn, Mass.	Twin Falls, Idaho	East Lansing, Mich.	Madison, Wis.	Toronto, Canada	Summit, Mont.	Fairbanks, Alaska
1949																												
July 30	548	422	225	402	423	534	607	556	747	432	511	617	466	563	287	716	621	218	578	405	505	508	639	282	592	427	702	162
July 31	635	622	439	580	560	662	509	459	651	591	304	622	244	554	528	682	305	709	500	223	270	240	664	517	682	451	697	371
Aug. 1	740	690	595	575	720	699	631	503	677	741	552	558	504	437	632	665	400	682	493	488	559	490	345	335	357	640	458	458
Aug. 2	737	683	592	562	692	707	706	415	657	763	433	488	305	418	665	672	269	406	312	351	458	438	620	428	686	305	666	340
Aug. 3	599	554	450	553	597	693	717	356	690	774	488	514	173	646	253	601	280	603	390	198	191	196	608	467	407	415	642	560
Aug. 4	568	430	372	570	558	700	695	363	630	772	390	700	147	532	534	685	126	627	135	136	245	179	583	370	625	601	690	537
Aug. 5	458	452	297	470	508	708	645	465	659	765	250	583	333	613	641	644	393	675	506	449	539	427	628	475	619	-----	685	105
Means	612	550	424	535	580	672	644	445	673	691	418	583	310	538	506	666	342	560	416	322	395	354	584	410	610	477	649	362
Departures	−30	−32	−108	−30	+109	+2	−22	−33	+79	−27	-----	0	−135	−19	+38	+140	−153	+9	−62	−167	−32	-----	+15	−18	+123	−21	+72	+17
Aug. 6	740	671	505	566	440	704	696	443	721	760	547	476	567	525	494	641	546	651	421	-----	593	563	573	293	609	566	653	249
Aug. 7	721	710	572	523	453	702	723	553	677	764	591	611	471	495	625	643	611	395	572	577	584	584	632	401	674	488	289	474
Aug. 8	673	621	491	552	513	709	670	585	616	760	580	392	565	456	551	552	606	643	621	621	574	608	639	492	623	557	715	151
Aug. 9	728	680	552	567	449	697	620	580	559	668	554	486	606	398	550	378	625	628	574	592	512	536	534	479	647	572	662	326
Aug. 10	549	629	547	527	656	691	627	584	435	735	557	650	520	616	555	401	621	608	566	620	618	557	636	433	591	554	658	534
Aug. 11	634	605	450	463	539	672	671	537	608	598	513	655	544	558	395	633	517	297	468	495	482	451	644	206	353	275	595	108
Aug. 12	727	690	616	575	389	679	642	523	405	748	472	643	253	595	199	548	163	375	144	135	170	207	615	157	158	508	388	197
Means	682	658	533	539	491	693	664	544	575	719	545	559	504	520	481	542	527	514	481	507	505	501	610	352	522	503	566	291
Departures	+38	+66	+11	−5	+31	+52	+10	+86	+29	+1	-----	−7	+81	−31	+6	+43	+32	+19	+14	+22	+83	-----	+56	−68	+46	−1	−16	−34
Aug. 13	633	626	605	562	400	683	638	452	563	749	357	602	159	641	499	115	147	568	246	156	102	199	609	451	445	594	630	393
Aug. 14	512	417	459	450	325	682	696	209	256	741	317	620	400	624	405	287	534	635	625	673	569	587	570	455	467	610	655	-----
Aug. 15	674	658	544	440	567	688	-----	126	460	733	354	690	304	652	207	391	403	533	402	541	543	588	590	429	615	579	590	524
Aug. 16	702	591	487	550	296	683	-----	504	586	732	490	534	137	631	528	588	645	585	527	544	574	594	590	437	438	547	608	475
Aug. 17	665	507	618	548	429	687	645	266	503	746	519	371	455	595	376	310	590	101	612	606	525	470	568	187	506	233	471	505
Aug. 18	580	365	566	536	572	703	632	177	599	747	203	558	101	634	301	310	280	548	296	297	314	327	555	408	425	519	552	425
Aug. 19	439	352	312	543	246	695	-----	514	311	748	613	558	422	611	542	178	525	655	375	549	576	608	599	451	584	627	331	460
Means	601	502	513	518	405	689	653	321	468	742	408	562	283	627	408	311	446	518	440	481	458	482	583	402	497	531	548	464
Departures	−30	−52	+19	−22	−18	+61	+34	−120	−29	+21	-----	−5	−98	+61	−14	−176	−5	+39	−1	+15	+58	-----	+56	−18	+37	+12	+11	+146
Aug. 20	661	581	428	484	424	-----	-----	445	706	727	525	660	653	591	666	484	650	636	627	656	656	621	600	454	581	619	623	476
Aug. 21	528	503	508	396	220	301	547	616	703	479	616	702	627	544	656	618	653	634	643	667	643	634	538	488	637	586	593	336
Aug. 22	684	549	489	457	131	377	656	558	694	703	526	499	465	432	422	614	574	448	565	636	546	574	376	464	610	520	614	178
Aug. 23	656	560	551	489	369	666	639	233	674	720	297	564	269	290	352	633	445	620	455	514	457	460	213	433	513	544	143	394
Aug. 24	714	569	492	490	470	669	628	417	647	717	284	651	292	398	557	622	248	580	217	316	301	355	444	277	589	376	457	364
Aug. 25	696	629	500	596	599	661	620	512	549	716	604	492	531	598	629	631	605	568	577	616	571	590	586	397	527	515	377	353
Aug. 26	542	499	528	586	525	642	620	492	598	706	496	521	504	576	505	443	564	508	532	579	516	519	585	350	519	419	604	294
Means	640	556	499	500	391	553	618	468	653	681	478	584	477	490	541	578	534	571	517	569	527	536	477	409	568	511	487	342
Departures	+12	+13	−2	−27	−60	−50	+15	+40	+174	+20	-----	+45	+100	−19	+100	+91	+70	+83	+55	+91	+131	-----	−46	−44	+117	+35	−28	+48
Aug. 27	582	409	539	566	583	292	138	508	321	160	492	431	430	473	441	383	520	486	482	532	507	440	428	199	394	317	587	257
Aug. 28	699	623	465	570	331	577	494	343	614	288	414	356	426	431	282	585	447	112	465	471	471	450	184	54	595	246	594	412
Aug. 29	599	550	306	555	506	640	624	552	579	676	301	506	229	502	342	517	216	562	181	154	158	168	561	277	600	263	567	400
Aug. 30	612	424	281	551	548	637	624	485	646	672	509	456	378	527	512	613	527	359	493	466	472	499	563	115	484	395	583	300
Aug. 31	654	666	332	568	542	633	612	232	654	670	187	323	170	382	326	605	444	430	349	322	313	364	556	276	386	317	565	252
Sept. 1	685	649	283	542	657	631	616	550	-----	656	495	555	477	459	554	606	430	603	338	354	361	390	550	384	604	401	548	304
Sept. 2	579	585	263	520	631	633	596	562	-----	655	563	348	548	228	589	553	614	602	578	618	568	608	514	457	586	535	339	254
Means	630	558	353	553	542	578	529	462	563	540	423	425	380	429	435	552	457	450	412	417	407	417	479	252	521	353	539	311
Departures	−7	−4	−124	+48	+81	+1	−37	+34	+4	−52	-----	−66	+21	−47	−3	+107	+35	+9	−6	+11	+32	-----	−13	−88	+103	−37	+28	+60

ACCUMULATED Ddepartures ON SEPT. 2, 1949

	+357	+308	−9534	----	+4739	+8792	+1204	−1967	----	+658	-----	-----	-----	−1155	+7091	−3199	+5503	+8806	+3280	+6391	+9611	----	+4186	−3374	+8512	+658	+623	----

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground, as received on a vertical surface facing south at Blue Hill, Mass., during August 1949*

Date	30	31	1	2	3	4	5	Mean	6	7	8	9	10	11	12	Mean	13	14	15	16	17	18	19	Mean
Gm cal cm⁻²	201	105	220	178	104	65	219	156	286	270	298	281	284	247	58	246	70	304	284	272	323	154	287	242

Date	20	21	22	23	24	25	26	Mean	27	28	29	30	31	1	2	Mean								
Gm cal cm⁻²	329	346	341	276	187	353	339	310	324	291	105	286	201	219	391	260	-----	-----	-----	-----	-----	-----	-----	-----

TABLE 4.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground, as received on a vertical surface facing north at Blue Hill, Mass., during August 1949*

Date	30	31	1	2	3	4	5	Mean	6	7	8	9	10	11	12	Mean	13	14	15	16	17	18	19	Mean
Gm cal cm⁻²	107	107	138	137	102	67	143	114	-----	127	114	119	106	100	60	104	59	109	112	108	115	95	100	100

Date	20	21	22	23	24	25	26	Mean	27	28	29	30	31	1	2	Mean								
Gm. cal cm⁻²	100	86	81	109	81	83	82	89	88	91	58	101	93	89	73	85	-----	-----	-----	-----	-----	-----	-----	-----

U. S. GOVERNMENT PRINTING OFFICE: 1949

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, August 1949

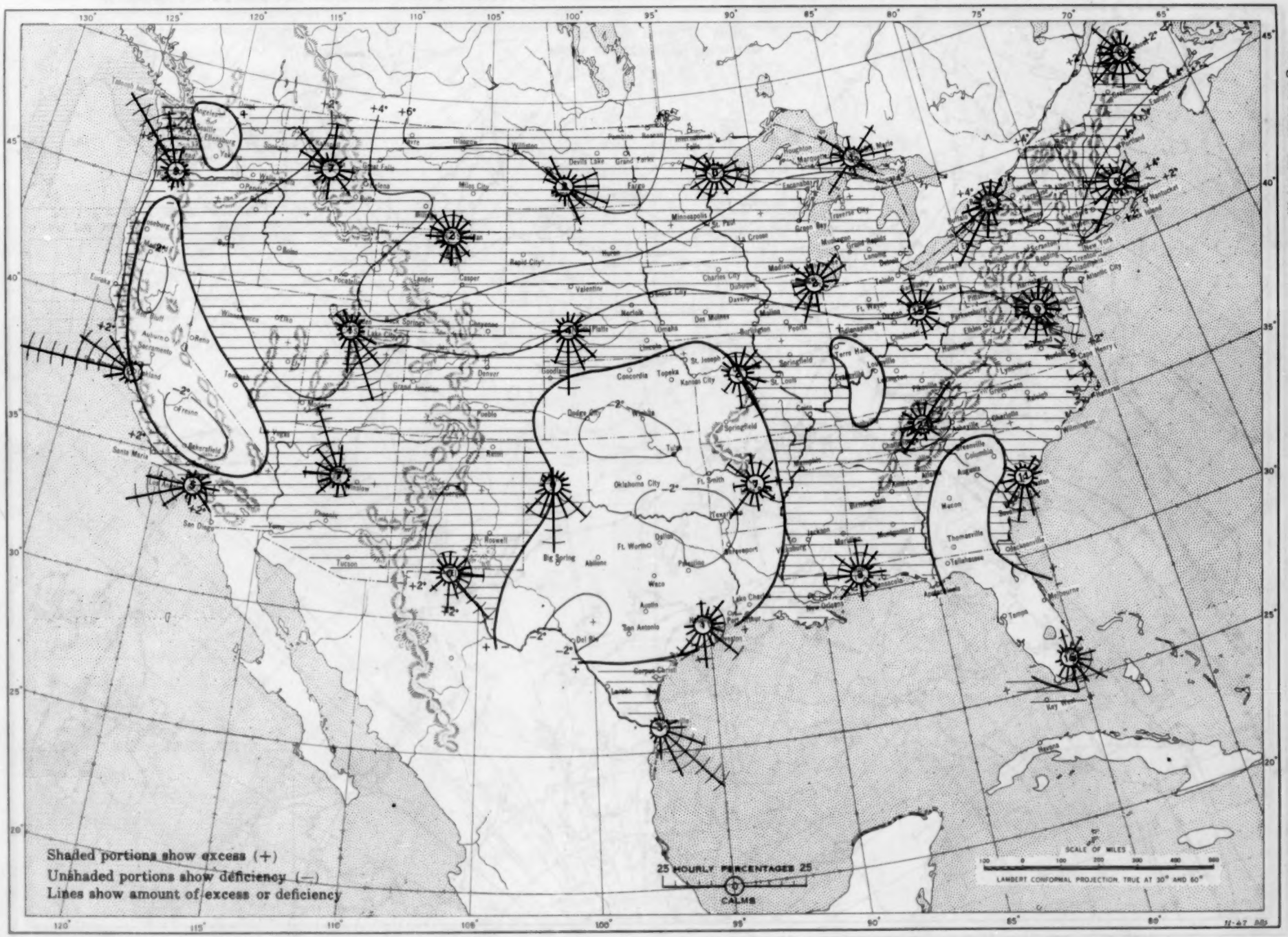
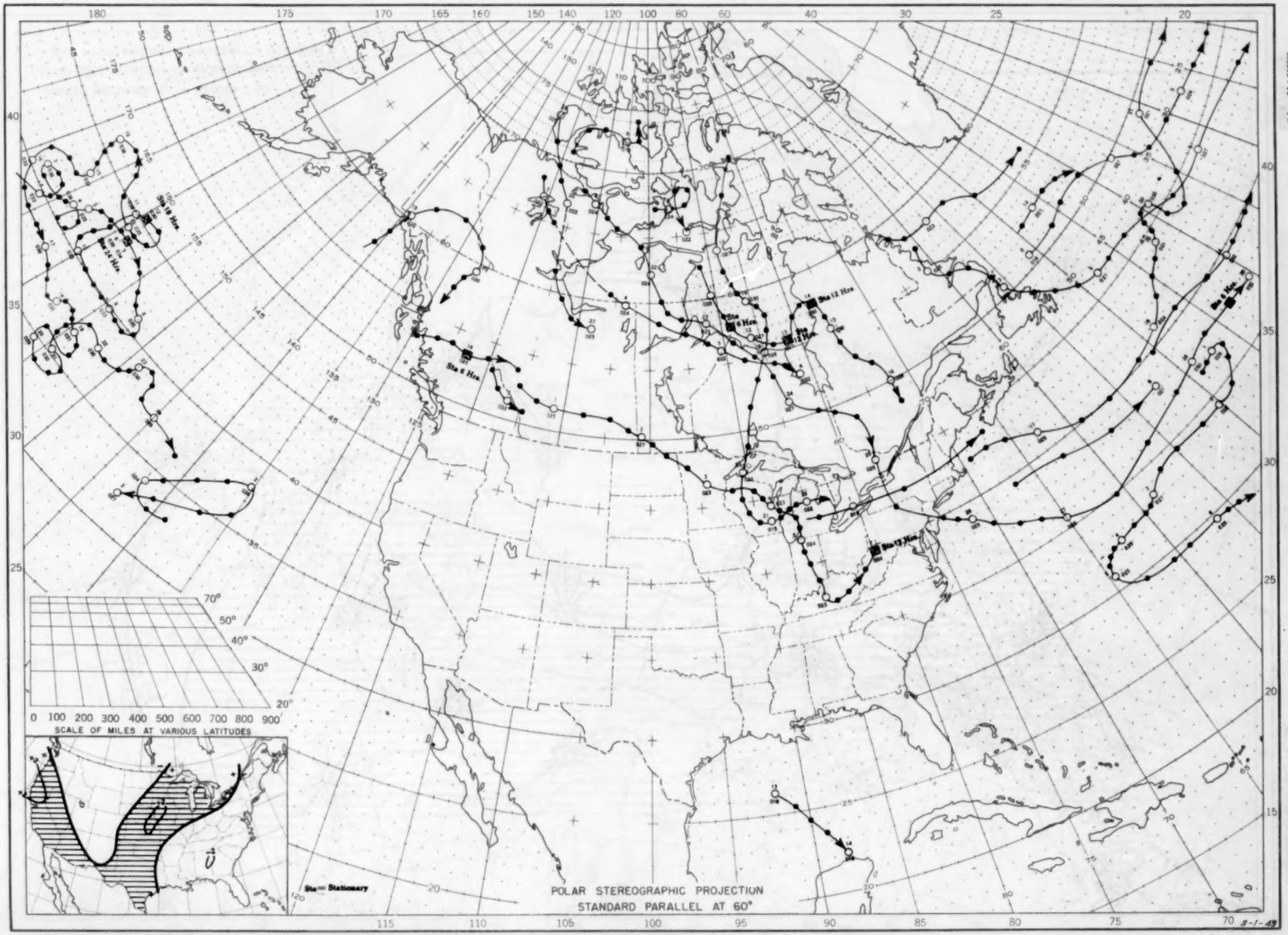

Shaded portions show excess (+)
Unshaded portions show deficiency (−)
Lines show amount of excess or deficiency
25 HOURLY PERCENTAGES 25
CALMS
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION. TRUE AT 30° AND 60°

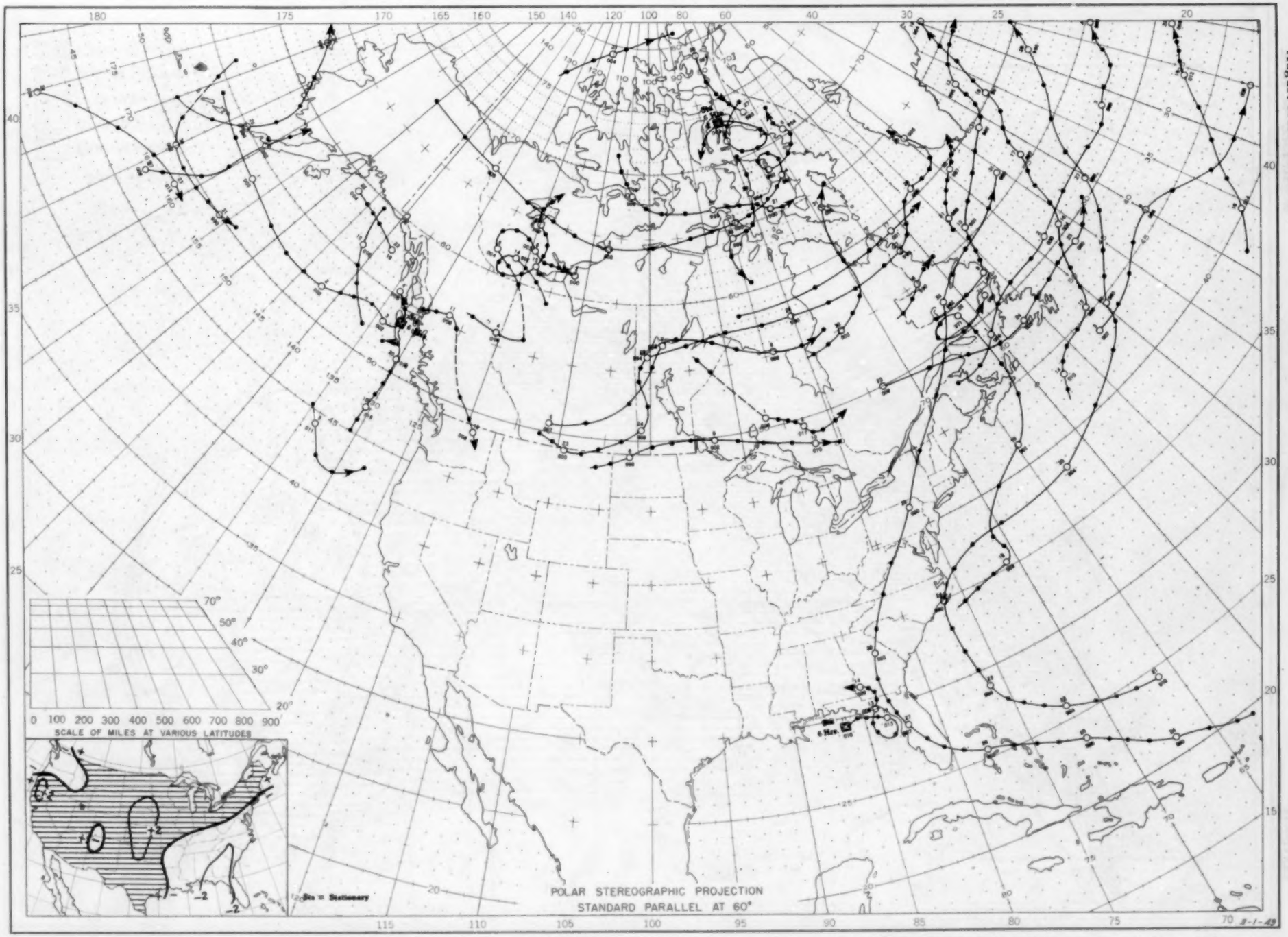
Chart II. Tracks of Centers of Anticyclones, August 1949. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, August 1949. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, August 1949

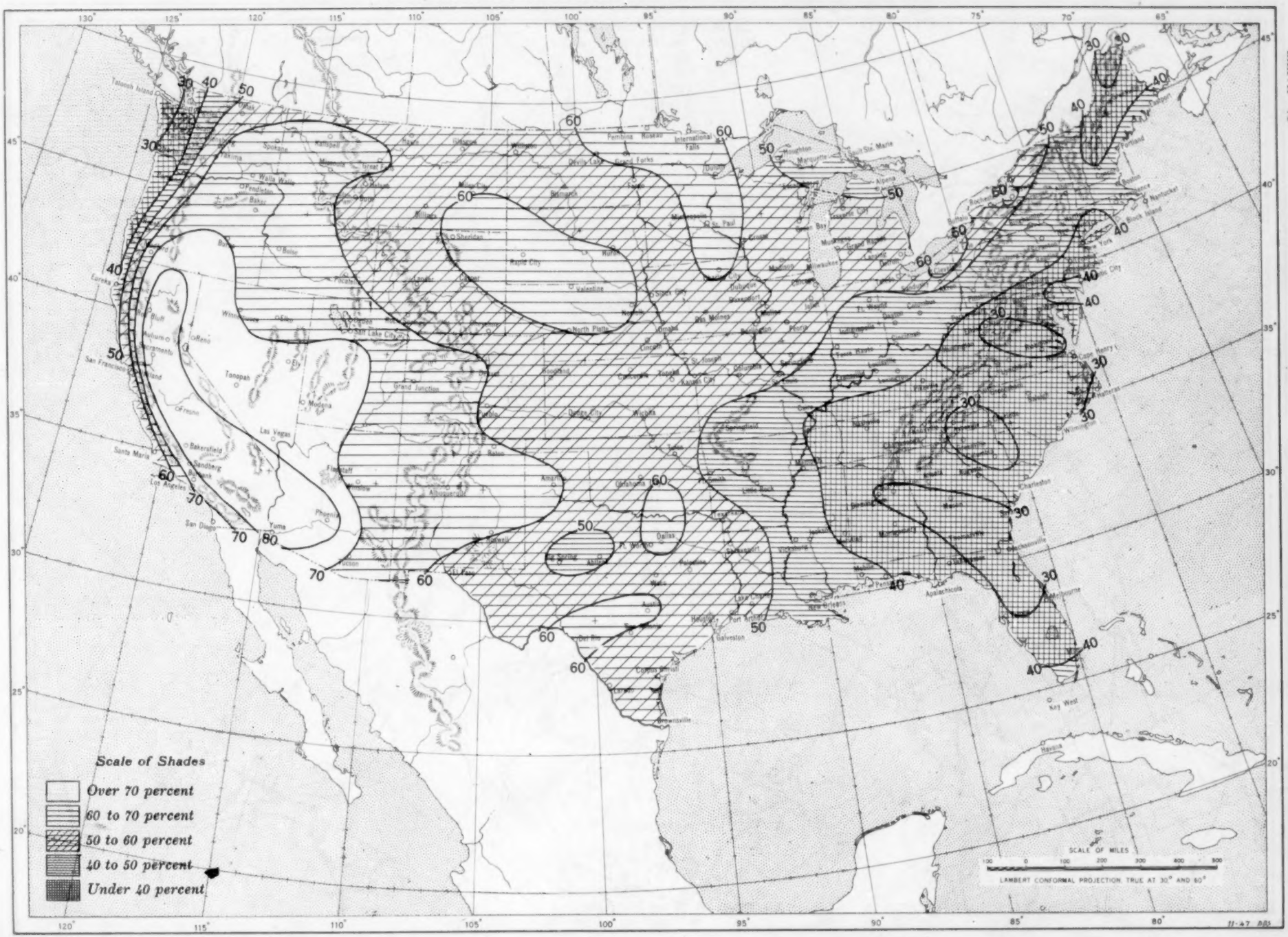

Scale of Shades
Over 70 percent
60 to 70 percent
50 to 60 percent
40 to 50 percent
Under 40 percent
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION, TRUE AT 30° AND 60°

Chart V. Total Precipitation, Inches, August 1949. (Inset) Departure of Precipitation from Normal

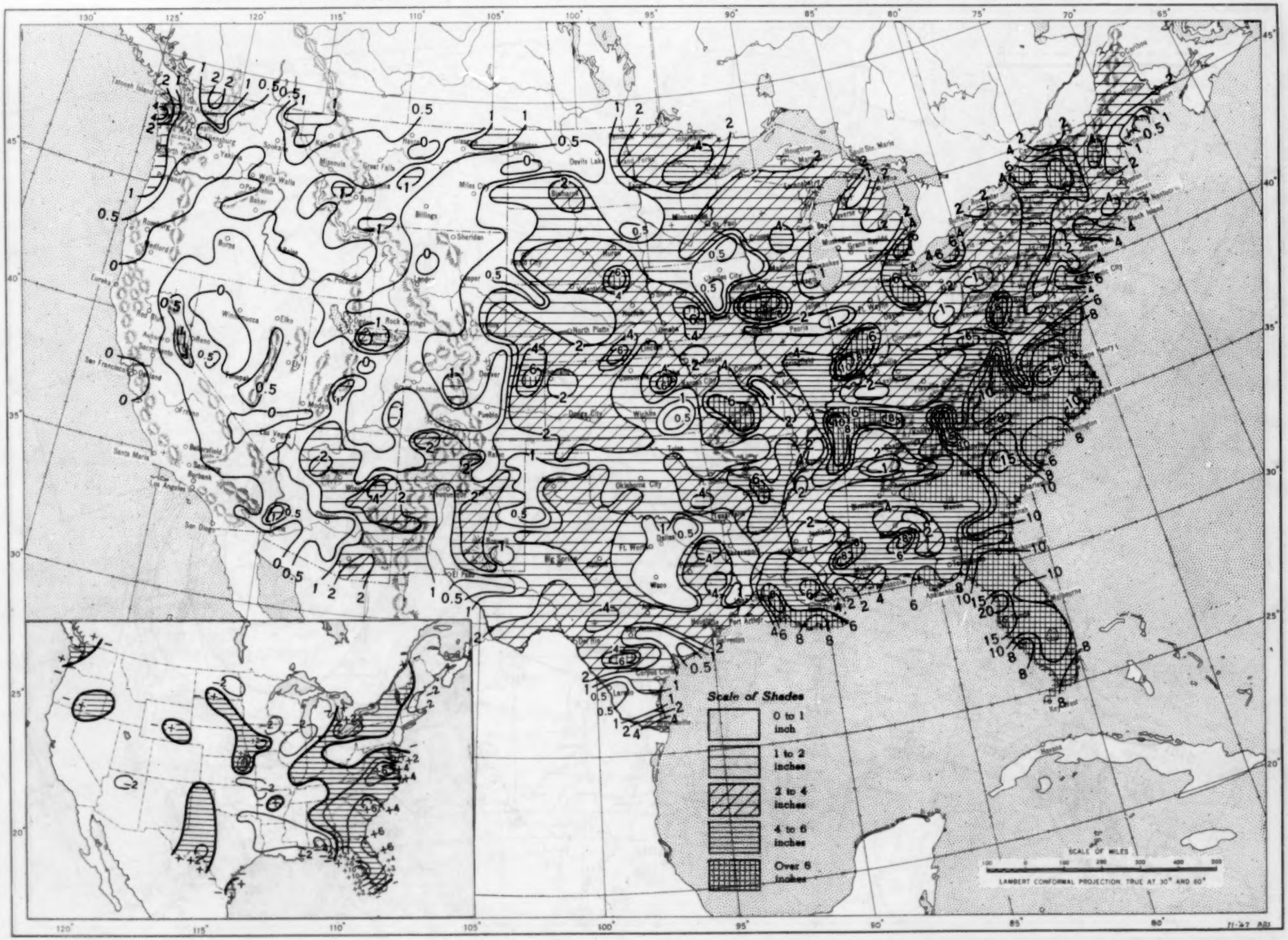

Scale of Shades
0 to 1 inch
1 to 2 inches
2 to 4 inches
4 to 6 inches
Over 6 inches
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION TRUE AT 30° AND 60°

Chart VI. Isobars (mb.) at Sea Level and Isotherms (°F.) at Surface; August 1949

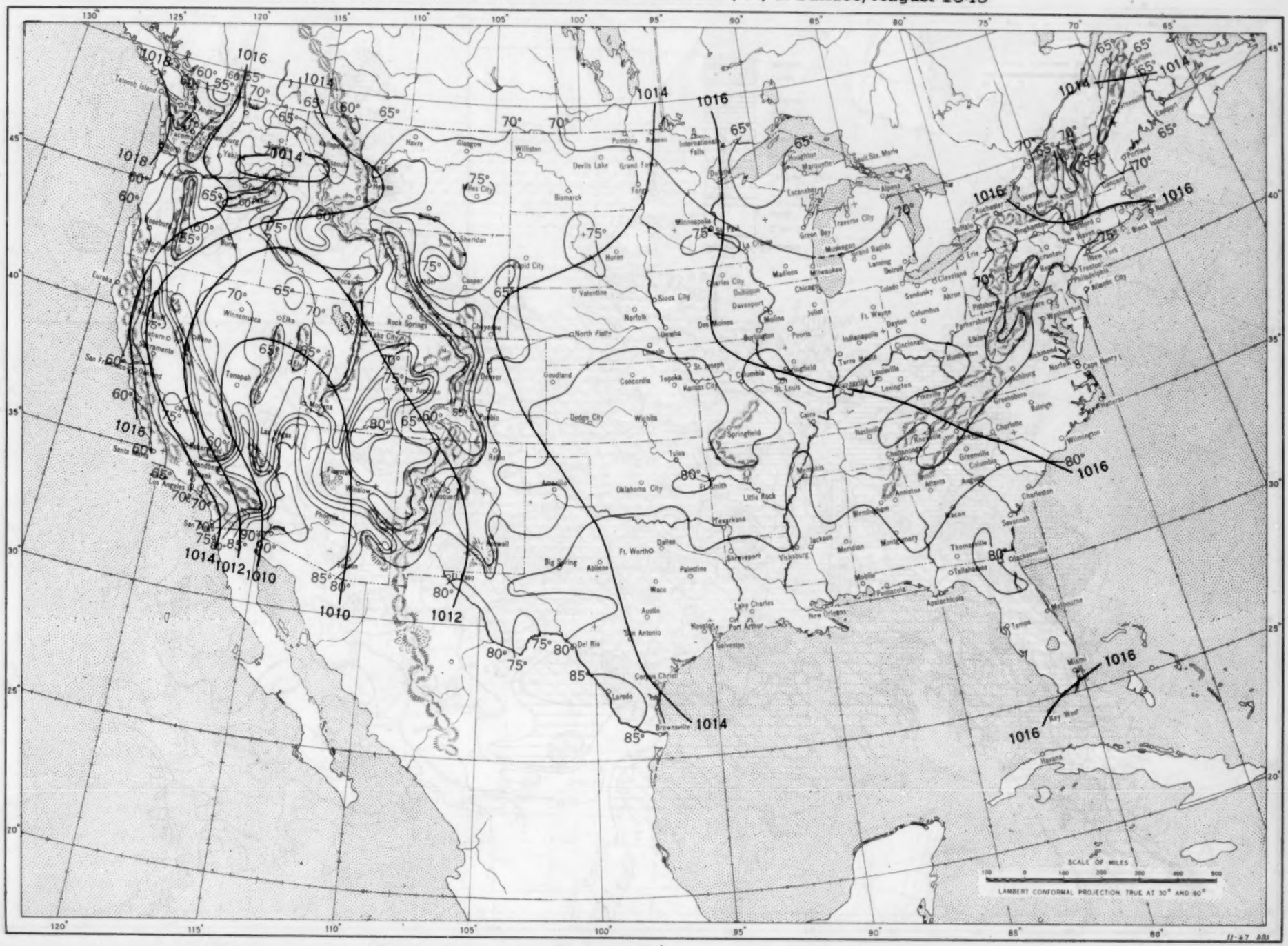
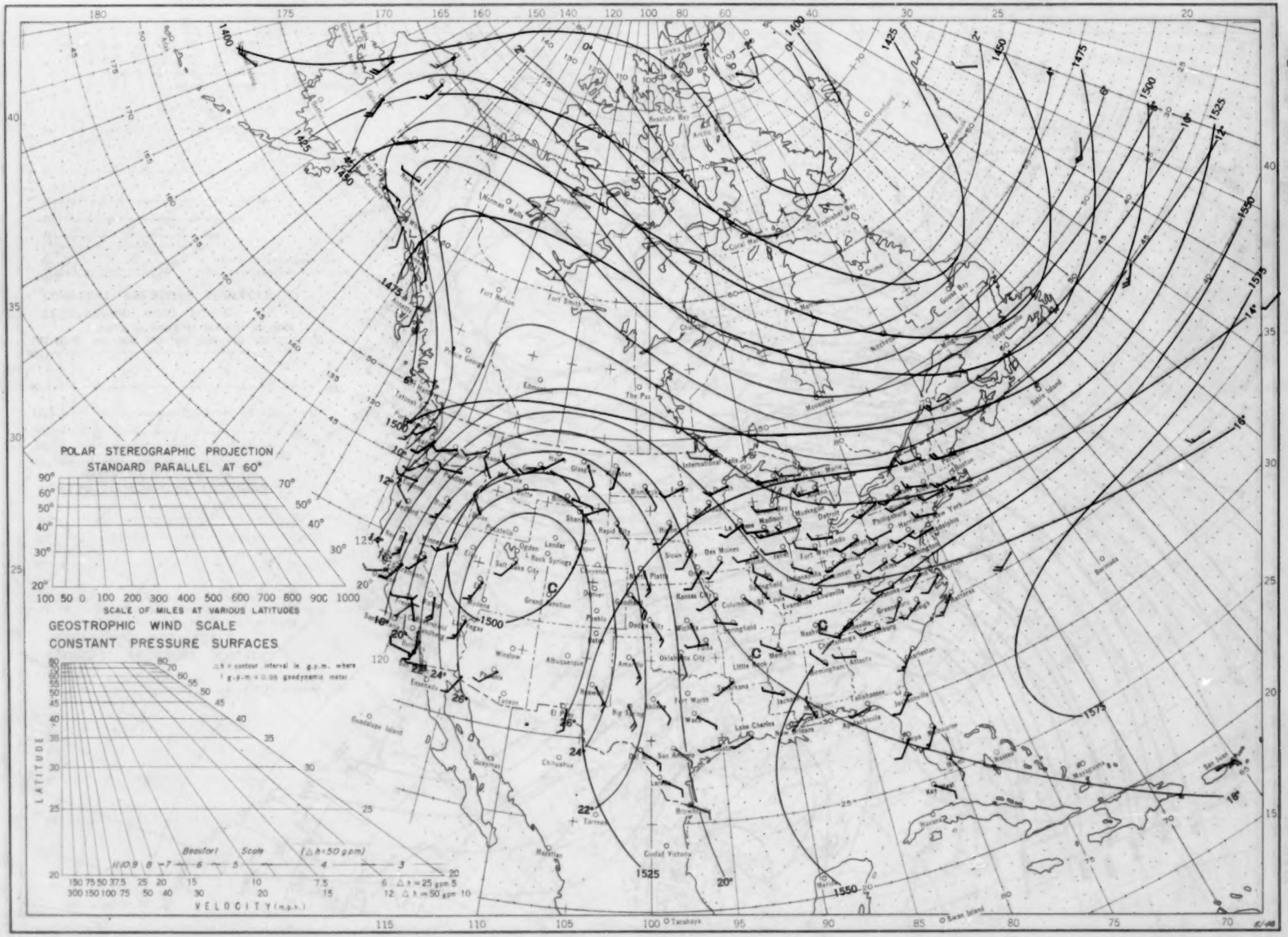
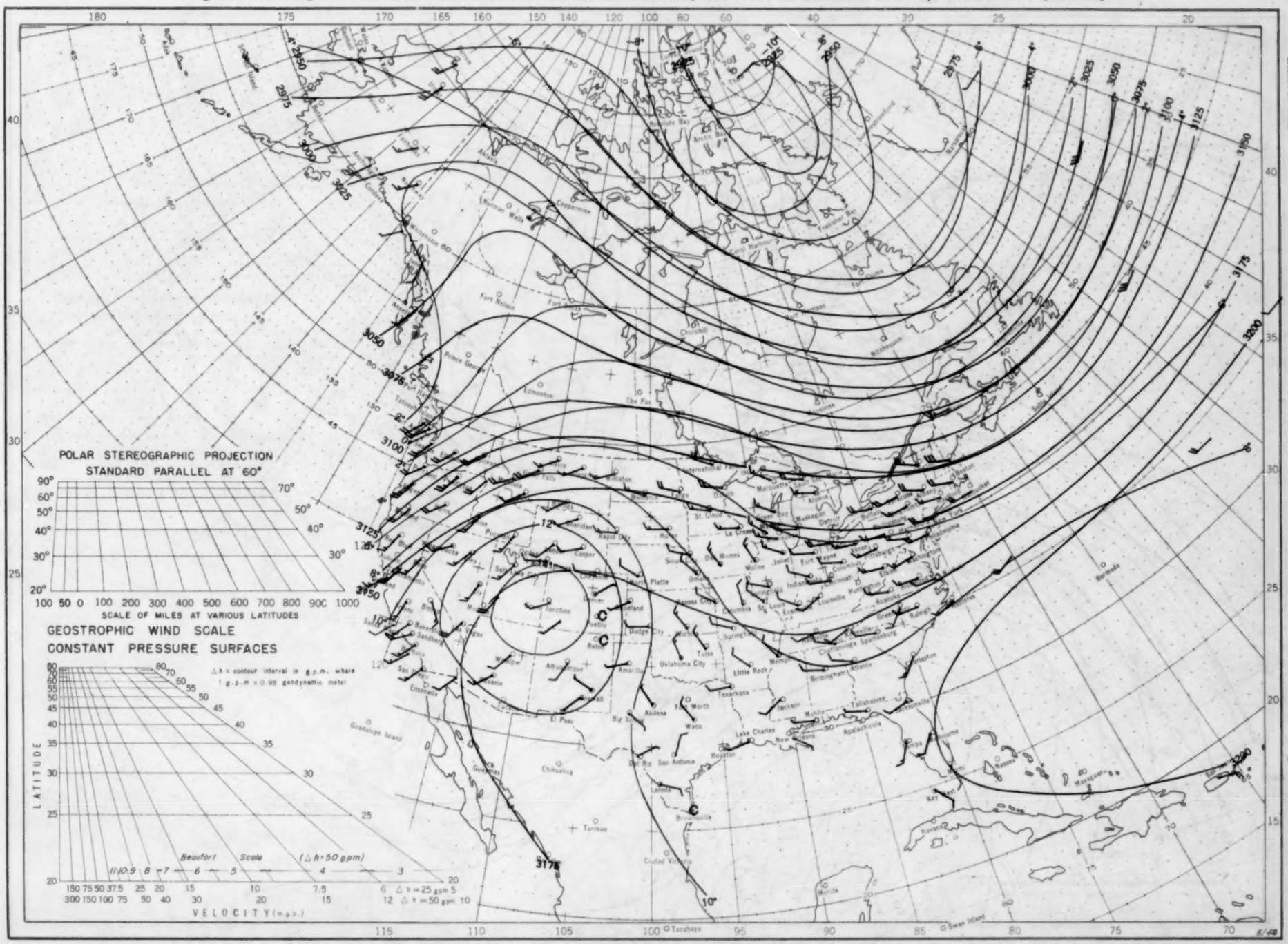


Chart VIII, August 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

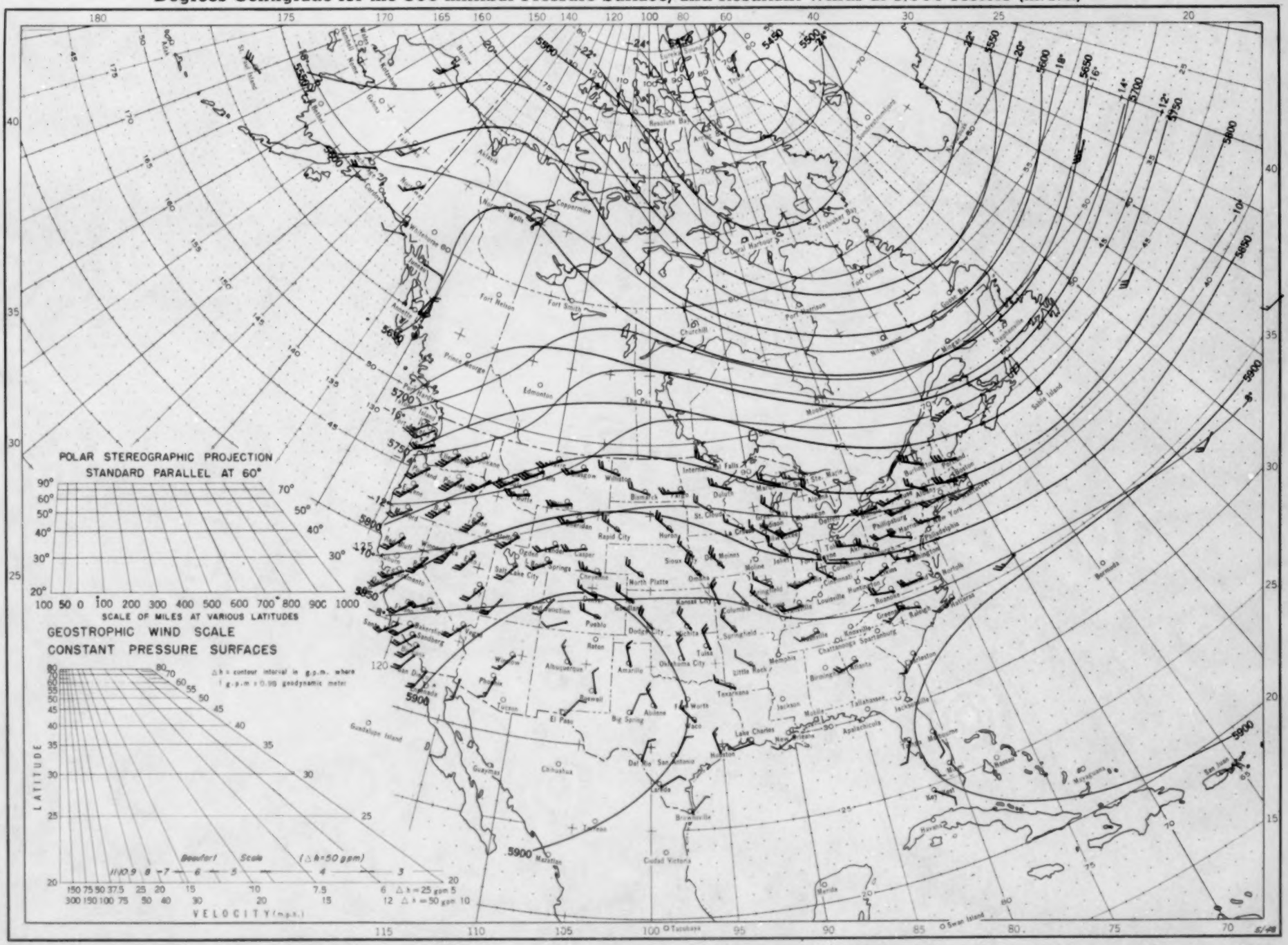
Chart IX, August 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

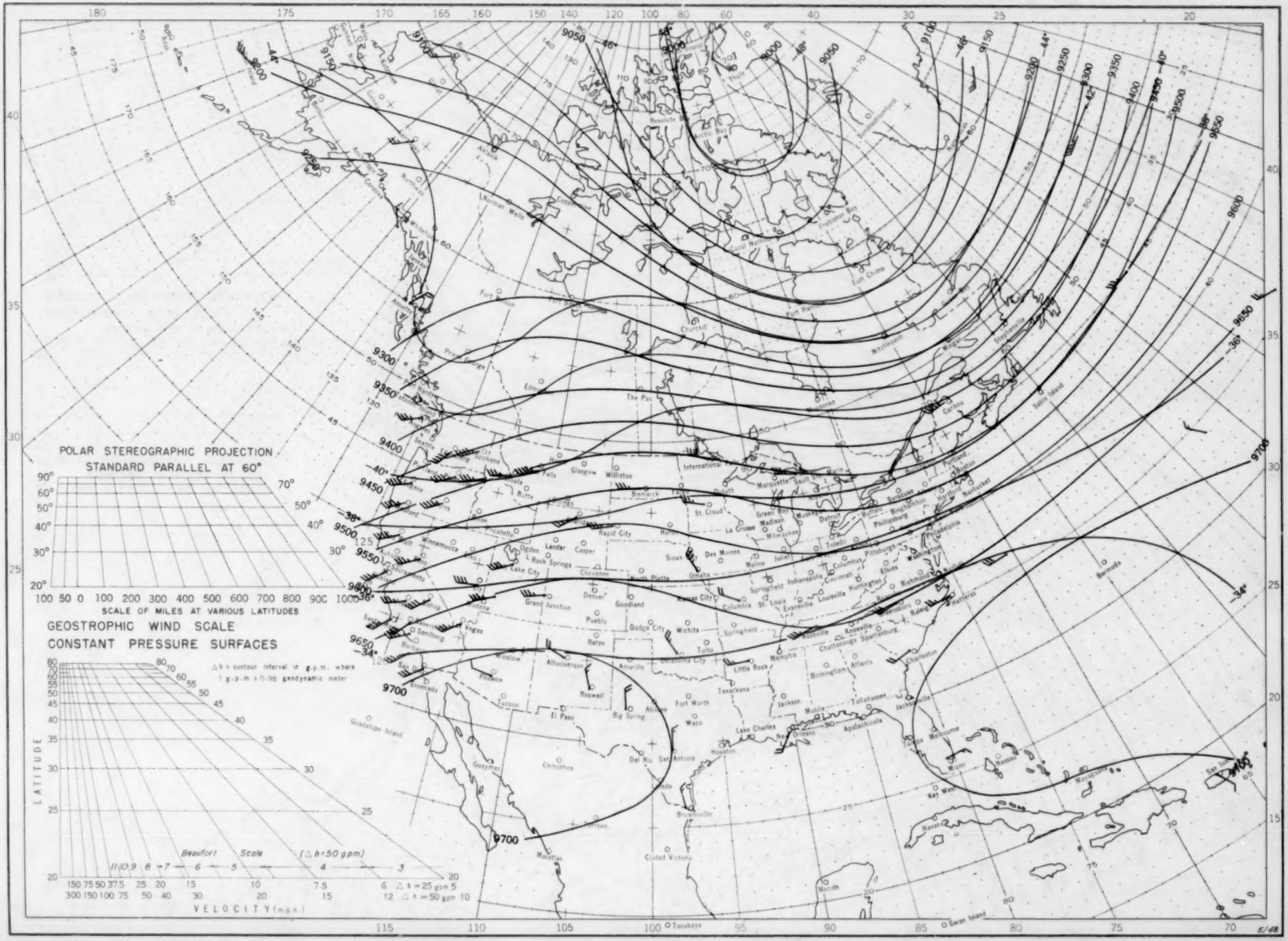
those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, August 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, August 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.